GRADED LESSONS IN ARITHMETIC

BY

W. F. Nichols

BOOK VII.

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IN

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BOOK VII.

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BY

WILBUR F. NICHOLS, A.M.

PRINCIPAL HAMILTON STREET SCHOOL, HOLYOKE, MASS.

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GENERAL INTRODUCTION.

1. These lessons have been prepared in the belief that it is a mistake to assume that one topic is to be finished before another is begun. The elements of many topics are here given in lower grades in explanations, illustrations, and examples easily understood by the younger pupils; and then the work in each topic is made more and more difficult through the various grades until it is finished. These examples have stood the test of the school-room, and in no case have they been found too difficult.

2. The arrangement of the topics is such that pupils in passing into a new grade find but few new topics, and many pupils are prepared for promotion from grade to grade at various times during the year, and are not obliged to wait for the annual promotions.

3. Such practical subjects as Percentage and Interest are introduced in the lower grades, where many pupils are found who are obliged to leave school before they reach the more advanced grades.

4. Clear conceptions of geometric forms and mensuration are introduced at an early period, that principles thus developed may be applied to many practical problems.

5. One or more lessons are given to the developing of a new topic; then the following lessons are so arranged as to give the pupils practice in applying the new topic in

connection with all the other topics previously learned. This constant review will be found very beneficial.

6. Few teachers will find the need of supplementary work, as so large a number of problems are given. On the other hand, few pupils should be required to solve all the problems. It is a good way to assign for required work for all the class that number of examples which even the slowest child can do, and then allow any child to work the remaining examples of the lesson as optional work.

7. The large amount of oral or mental examples will be appreciated by those who believe that ten minutes each day should be given to work of this kind. These are not mental gymnastics, but plain, practical, every-day questions.

8. The introduction of Algebra and Geometry in the higher grades will be found beneficial.

9. The methods here advocated are the shorter methods found in daily use among bankers, mechanics, and merchants.

10. Commencing in Book IV., and continuing through the series, we have frequently given only statements of certain problems. This tends to develop thought power, for the pupils must determine first what can be found, and then how to find it.

The author desires to express his acknowledgments for many valuable suggestions to Mr. C. H. Morss, Superintendent of Schools, of Medford, Mass.

WILBUR F. NICHOLS.

HOLYOKE, *September*, 1897.

INTRODUCTION TO BOOK VII.

THE plan pursued in this series of Arithmetics is that of giving constant practice in those principles already acquired at the same time that new topics are presented. Accordingly, many review examples in percentage are given as the subject is more fully developed.

The form lessons, which have been an important part of the previous books, are here continued, and their scope broadened to include the simple principles of concrete geometry, the mastery of which renders the transition to theoretical geometry devoid of the usual difficulties.

The first principles of Algebra are also introduced. There are, throughout the arithmetical portion of the book, many examples that should be solved by letting x stand for the unknown term. Wherever this method of solution is the simpler, teachers should encourage children to make use of it. Putting into algebraic language the conditions of an arithmetical problem forms an easy transition from the concrete language of arithmetic to the abstract and general language of algebra.

TABLES OF WEIGHTS AND MEASURES

FOR REFERENCE.

LINEAR MEASURE

12 inches (in.)	= 1 foot (ft.).	5½ yards, or 16½ feet	= 1 rod (rd.).
3 feet	= 1 yard (yd.).	320 rods, or 5280 feet	= 1 mile (m.).

SQUARE MEASURE.

144 square inches (sq. in.)	= 1 square foot (sq. ft.).
9 square feet	= 1 square yard (sq. yd.).
30¼ square yards, or 272¼ square feet	= 1 square rod (sq. rd.).
160 square rods	= 1 acre (a.).
640 acres	= 1 square mile (sq. m.).

SOLID OR CUBIC MEASURE.

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.).
27 cubic feet	= 1 cubic yard (cu. yd.).

WOOD MEASURE.

16 cubic feet	= 1 cord foot (cd. ft.).
8 cord feet, or 128 cubic feet	= 1 cord (cd.).

LIQUID MEASURE.

4 gills (gi.)	= 1 pint (pt.).
2 pints	= 1 quart (qt.).
4 quarts	= 1 gallon (gal.).
1 gal.	= 231 cubic inches.

DRY MEASURE.

2 pints (pt.)	= 1 quart (qt.).
8 quarts	= 1 peck (pk.).
4 pecks	= 1 bushel (bush.).
1 bushel	= 2150.42 cubic inches.

AVOIRDUPOIS WEIGHT.

16 ounces (oz.)	= 1 pound (lb.).
2000 pounds	= 1 ton (t.).
2240 pounds	= 1 long ton

CIRCULAR MEASURE.

60 seconds (″)	= 1 minute (′).
60 minutes	= 1 degree (°).
360 degrees	= 1 circumference (circ.).

MISCELLANEOUS TABLE.

12 units	= 1 dozen.
12 dozen	= 1 gross.
12 gross	= 1 great gross.
20 units	= 1 score.
24 sheets	= 1 quire.
20 quires	= 1 ream.

TIME MEASURE.

60 seconds (sec.)	= 1 minute (m.).
60 minutes	= 1 hour (h.).
24 hours	= 1 day (d.).
7 days	= 1 week (wk.).
365 days	= 1 common year (c. yr.).
366 days	= 1 leap year (l. yr.).
100 years	= 1 century (C.).

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GRADED LESSONS IN ARITHMETIC.

BOOK VII.

LESSON 1.

1. My furniture, worth $1,800, is insured for $\frac{2}{3}$ of its value at $\frac{3}{4}\%$.

2. If a quantity of provisions will last 630 men 108 days, how long will the same last 210 men?

3. In a school 174 pupils are present, and 6 are absent. Find the per cent of attendance.

4. Supply the second term in the proportion $7 : x = 12 : 36$.

5. At $8 a cord, find the cost of a pile of wood 18 ft. 6 in. long, 4 ft. wide, and 7 ft. 9 in. high.

6. Bought 175 bu. of wheat for $315, and sold it for $2 a bushel. What was the gain per cent?

7. On a commission of $2\frac{1}{2}\%$ I sold 400 bales of cotton, each weighing 480 pounds, at $32¢$ a pound.

8. Selling-price, $125.45; profit, $8\frac{1}{3}\%$.

9. Cost $88.60, loss $7\frac{1}{2}\%$.

10. A house which cost $4,800 rents for $24 a month. The expenses on it are $48 annually. What rate per cent does it yield?

11. How many bricks will be required to build a wall 84 ft. long, 32 ft. high, and 1 ft. thick?

12. At $9¢$ a cubic foot, what will be the cost of a block of stone 9 ft. long, $5\frac{1}{2}$ ft. wide, and 4 ft. thick?

1. A grocer bought flour at $4.35 a barrel, paying for it $1,148.40, and sold it at $5.15 a barrel.

2. How many 3-inch cubes are there in a block 27 in. long, 12 in. wide, and 9 in. thick?

3. Six men agree to expend the same amount in the purchase of books. The first pays $.25 for each book; the second, $.27; the third, $.40; the fourth, $.75; the fifth, $.80; and the sixth, $1.20. What is the least number of books that all can buy?

4. Time sheet:

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Wages.
J. Smith,	7	8	8	7½	6	5	$1.00
T. Windsor,	7	8	8	6	6	5	.85
B. Morse,	7½	8	8½	4	8	4	1.25
E. Titus,	7½	8	8	3	8½	5	.90
R. Marshall,	6	8	8	2	9	5	.95

Eight hours' labor is a full day.

5. July 5, 1898, W. H. Humeston buys of the Central Book Store on ⁄c 3 quires foolscap @ 27¢; 1 set Dickens, $12.50; 3 histories @ 65¢. July 18 he buys on ⁄c 15 vols. Irving @ 45¢; 6 quires paper @ 23½ ¢; 1 doz. pencils @ 4¢ each. Aug. 5 he buys on ⁄c 3 Warren's Physical Geographies @ $1.65. Aug. 10 he pays $10 on ⁄c. Sept. 12 he buys 1 doz. Drawing-books @ 12½ ¢ each. Oct. 10 he pays his account in full.

Render an itemized account Aug. 1.

Render a statement and bill Sept. 1 and Oct. 1.

Render a receipted bill Oct. 10.

6. By selling an article for $21 I lost 12½%. Find the cost.

7. A sold B a carriage which cost him $160 at 12½% profit. B sold it to C at a profit of 10%. What per cent would A have gained if he had sold it at the price C paid?

1. Multiply 45 bu. 3 pk. 6 qt. 1 pt. by 15.

2. Divide 212 m. 26 rd. 1½ yd. by 7.

3. Add 43 A. 32 sq. rd. 127 sq. ft.; 240 A. 20 sq. rd. 200 sq. ft.; 95 A. 25 sq. rd. 75 sq, ft.; 12 A. 100 sq. ft.; 137 sq. rd. 30 sq. ft.

4. How many acres in a farm 225 rd. long and 175 rd. wide?

5. How many cubic feet in a room 18 ft. long, 17 ft. wide, and 15 ft. high?

6. In 3,538,944 cu. in. how many cubic yards?

7. Reduce 4 mi. 213 rd. 15 ft. to inches.

8. How much rice at 8¢ a pound will pay for 5 bu. 3 pk. of cherries at 9¢ a quart?

9. Find the least common multiple of 13, 39, 56, 63.

10. Find the greatest common divisor of 315, 945, and 63.

11. How many are $72\frac{9}{11} \times 22\frac{4}{9}$?

12. If $\frac{9}{10}$ of a basket of peaches cost $\$\frac{5}{8}$, what is the cost of $43\frac{1}{5}$ baskets?

13. If $\frac{2}{3}$ of an acre of land cost $\$66\frac{2}{3}$, how much will $8\frac{3}{4}$ acres cost?

14. What is the value of a pile of wood 48 ft. long, $8\frac{3}{4}$ ft. high, and 4 ft. wide, at $6.50 a cord?

15. Multiply 27 millionths by 12 hundredths, and divide the product by 324 thousandths.

16. Change .05729 of a mile to a compound number.

17. Change $\frac{5}{18}$ to a decimal fraction.

18. A farmer had $\frac{1}{4}$ of his sheep in one pasture, $\frac{1}{3}$ in another, $\frac{1}{5}$ in another, and the remainder, 26, in a fourth. How many sheep had he?

19. Bought a box of sugar containing 477 lb. for $30. Sold $\frac{1}{3}$ of it at 8¢ a pound, and the remainder at $12\frac{1}{2}$¢ a pound.

20. Reduce $\frac{2}{3}$ of $\frac{7}{8}$ of $\frac{4}{7}$ of $\frac{9}{10}$ of $\frac{6}{11}$ to a decimal fraction.

21. Take four hundred and twenty-five ten-thousandths from ten thousand, and multiply the remainder by ten hundredths.

1. I sold a bicycle for \$81 at a loss of 10%; for what should it be sold to gain 10%?

1. S. P. at 1st loss, = \$81.
2. S. % at 1st loss, = 90.
3. S. % at x gain, = 110.

$110 : 90 = \frac{110}{90} = \frac{11}{9}$.

$\frac{11}{9}$ of \$81 = \$99.

The first three statements need no explanation.

What is the ratio or comparison of 110% (which we wish to find) to 90% (which we know)? It is as 110 : 90 or $\frac{110}{90}$ or $\frac{11}{9}$. If it is $\frac{11}{9}$ of the second statement, it must be $\frac{11}{9}$ of the first statement, because the first and second are equal, both representing the Selling Price at first loss; or by Proportion, 110 (the % at x gain) is to 90 (the % at 1st loss) as x (the selling price at x gain) is to 81 (the selling price at 1st loss). $110\% : 90\% = \$x : \$81 \cdot 90x = 8{,}910 \cdot x = 99$.

2. If by selling a farm for \$1,425, a farmer gains 14%, what per cent would he have gained by selling it for \$1,600?

1. S. P. at 1st gain, \$1425. $1600 : 1425 = \frac{1600}{1425} = \frac{64}{57}$.
2. S. % at 1st gain, 114. $\frac{64}{57}$ of $114\% = 128\%$.
3. S. P. at x gain, 1600. $128\% - 100\% = 28\%$.

By Proportion:

$1600 : 1425 = x : 114.$
$1425x = 18248.00$
$x = 128$
$128\% - 100\% = 28\%$

\$1600 (the S. P. at x gain).
: \$1425 (the S. P. at 1st gain) =
$x\%$ (the selling % at \$1600) :
114% (the selling % at 1425).

3. Sold a farm for \$8,128, and made 27 per cent on the cost. What per cent should I have gained had I sold it for \$9,600?

4. A pair of horses were sold for \$297, at a gain of 35%. What would have been the gain per cent if sold for \$253?

5. A horse was sold for \$144, at a gain of 20%. At what price would it have been sold if there had been a loss of 20%?

6. A piano was sold for \$252, which was at a gain of 12%. At what price would it have been sold to gain 25%?

7. A boy sold a pair of skates for 92 cents, and gained 15%. At what should he have sold them to gain $18\frac{3}{4}\%$?

8. Sold a lot of hay for \$644, at a gain of 15%. At what price should it have been sold to gain 20%?

TO FIND INTEREST.

What is the interest of:

1. $845 for 6 mo. 24 da. at 4%?
2. $46.50 for 123 days at 6%?
3. $74.60 for 1 yr. 5 mo. at 5%?
4. $2,463.75 for 11 mo. 23 da. at 4½%?
5. $5,900 for 3 yr. 6 mo. 17 da. at 7%?
6. $400.50 for 2 yr. 11 mo. 3 da. at 4%?
7. $10,000 for 63 days at 5%?
8. $640.80 for 4 yr. 7 mo. 11 da. at 7%?
9. $16,420 for 9 mo. 24 da. at 6½%?
10. $734.75 for 3 yr. 9 mo. at 4%?
11. $459.28 from Dec. 14, 1898, to May 5, 1899, at 4½%?
12. $658.48 from Aug. 17, 1897, to Apr. 4, 1899, at 8%?
13. $2,184 from Jan. 24, 1898, to Mar. 30, 1901, at 6%?
14. $609.50 from Mar. 5, 1896, to Sept. 14, 1898, at 4½%?
15. $489.25 from May 5, 1898, to Aug. 11, 1899, at 5%?
16. $625.57 from Aug. 15, 1897, to Dec. 29, 1902, at 3½%?
17. $647.48 from Sept. 30, 1897, to May 5, 1899, at 7½%?
18. $492 from Aug. 31, 1898, to Dec. 30, 1899, at 3½%?
19. $1,827 from Jan. 16, 1898, to Oct. 11, 1899, at 4%?
20. $945.96 from June 4, 1898, to Sept. 10, 1900, at 4½%?
21. $2,846 for 8 yr. 4 mo. 12 da. at 6½%?
22. $862 for 4 yr. 7 mo. 22 da. at 8%?
23. $8,624 for 1 yr. 2 mo. 17 da. at 5%?
24. $946.25 for 89 days at 4½%?
25. $3,010 for 2 yr. 7 mo. 7 da. at 8%?
26. $480 for 3 yr. 1 mo. 24 da. at 7%?
27. $847.25 for 1 yr. 8 mo. 7 da. at 4%?
28. $756.75 for 2 yr. 2 mo. 5 da. at 7½%?
29. $1,050 for 3 yr. 5 mo. 3 da. at 6%?
30. $2,500 for 4 yr. 11 mo. 9 da. at 6%?
31. $800 for 115 days at 3½%?

TIME, RATE, AND INTEREST GIVEN, TO FIND THE PRINCIPAL.

1. What principal at 6% will yield $225 int. in 2 yr. 6 mo.?

$.01 = int. of $1 for 2mo.
$.15 = int. of $1 for 2 yr. 6mo.
$225 : $.15 = $x : $1.
$.15x = $225.
$x = $1500.

What is the interest of $1 for 2 yr. 6 mo.? What is the interest of $x as stated in the example? What is the ratio of $225 to $.15? What is the ratio of $x to $1? Since these two ratios are equal, write them as a proportion. Find the value of x.

2. In the example above which term is wanting? What sum did you take in place of it? What rate and time did you use?

NOTE. — It was not necessary to take $1; any sum would do. We need to find an interest using the same rate and time, so as to form our comparison.

3. State a rule for finding the Principal when the Interest, Time, and Rate are given.

4. What principal at 5% will yield $400 in 7 mo. 15 da.?

.0375 int. of $1 for 7 mo. 15 da. at 6%.
.03125 int. of $1 for 7 mo. 15 da. at 5%.
$400 : $.03125 = $x : $1.
$.03125x = $400. $x = $12,800.

NOTE. — In these Examples, to be exact the whole of the interest of $1.00 should be kept.

5. What principal on interest at 6% for 3 yr. 4 mo. will yield $80?

6. What principal on interest at 6% will gain $15 in 2 yr.?

7. At 5% what principal will gain $20 in 4 yr.?

8. What principal at 7% will yield $350 in 1 yr.?

9. At 6% what principal will yield $300 in 6 mo.?

10. Interest, $65; time, 5 yr.; rate, 5%; find the principal.

11. Rate, 8%; time, 12 d.; interest, $8; find the principal.

12. What sum of money at 4½% will yield $792 interest in 1 yr.?

13. The interest for 7 yr. 1 mo. 19 d. at 5% is $128.45. What is the principal?

PRINCIPAL, INTEREST, AND TIME GIVEN, TO FIND THE RATE.

1. At what rate will \$900 gain \$231 in 3 yr. 8 mo.?

\$9.00 = int. on \$900 for 2 mo. at 6%.
\$198 = int. on \$900 for 3 yr. 8mo. at 6%.
\$33 = int. on \$900 for 3 yr. 8 mo. at 1%.
\$231 : \$33 = x% : 1%.
$33x = 231$. $x = 7$.

What is the interest on \$900 at 1% for 3 yr. 8 mo.? What is the interest of \$900 at x% as stated in the example? How does the interest given at x% compare with the interest you get at 1%? Form the two ratios into a proportion, and find the value of x.

2. State a rule for finding the rate when principal, interest, and time are given.

At what rate will:

3. \$426 gain \$63.90 in 2 yr. 6 mo.?
4. \$62.75 gain \$8.785 in 2 yr. 4 mo.?
5. \$120 gain \$24.92 in 3 yr. 5 mo. 16 da.?
6. \$600 gain \$81 in 3 yr.?
7. \$340 gain \$59.50 in 3 yr. 6 mo.?
8. \$7250 gain \$435.00 in 1 yr. 6 mo.?
9. \$270.00 gain \$45.09 in 2 yr. 9 mo. 12 da.?
10. \$240 gain \$45.90 in 4 yr. 3 mo.?
11. \$333 gain \$80.47½ in 4 yr. 10 mo.?
12. \$60 gain \$13.10 in 3 yr. 7 mo. 20 da.?
13. \$40 gain \$8.88 in 5 yr. 6 mo. 18 da.?
14. \$124 gain \$45.33¾ in 5 yr. 7 mo. 15 da.?
15. \$240 gain \$56.85 in 6 yr. 3 mo. 24 da.?
16. \$1,080 gain \$53.85 interest in 11 mo. 29 da.?
17. \$620.00 gain \$57.35 interest in 1 yr. 6 mo. 15 da.?
18. \$725.00 gain \$40.02 interest in 2 yr. 3 mo. 18 da.?
19. \$800.00 gain \$192.00 interest in 3 yr.?
20. \$400.00 gain \$75.00 interest in 2 yr. 6 mo.?
21. \$600.00 gain \$56.00 interest in 2 yr. 4 mo.?
22. \$1,750.00 gain \$367.50 interest in 2 yr. 4 mo.?

PRINCIPAL, INTEREST, AND RATE GIVEN, TO FIND THE TIME.

1. In what time will \$940 at 6% gain \$432.40?

\$56.40 = int. of \$940 for 1 yr. at 6%.

\$432.40 : \$56.40 = x yr. : 1 yr.

$56.40x = 432.40$.

$x = 7\frac{2}{3}$ yr.

$x = 7$ yr. 8 mo.

What is the interest of \$940 for 1 yr. at 6%? What is the interest stated in the example for x years at 6%?

Form the time and interest into a proportion, and find the value of x.

2. State a rule for finding the time when the principal, interest, and rate are given?

In what time will:

3. \$142.64 gain \$13.105 at 4%?

4. \$500 gain \$5.00 at 4%?

5. \$900 gain \$13.50 at 6%?

6. \$725 gain \$10.15 at $3\frac{1}{2}$%?

7. \$280 gain \$4.05 at $6\frac{1}{2}$%?

8. \$350 gain \$78.75 at 7%?

9. \$254 gain \$44.45 at 5%?

10. \$75 gain \$15.80 at 4%?

11. \$850.50 gain \$136.08 at 5%?

12. A man loaned \$680 at 5%, and received \$8.50 interest. For how long a time was the money loaned?

13. How long will it take \$200 to double itself at 4%?

14. How long will it take \$1,115.36 to amount to \$1,204.838 at $4\frac{1}{2}$%?

NOTE.— First find the interest.

15. How long a time will it require \$1,250 to amount to \$1,512.50 at 7%?

16. The face of a note is \$185.40, rate of interest 6%, and the interest \$24.72. How long has it run?

17. In what time will \$600 gain \$126.00 at 6%?

18. In what time will \$1,800 gain \$325.20 at 8%?

DEFINITION OF TERMS USED IN PERCENTAGE.

1. Profit is the excess of the selling-price over the cost.

2. Loss is the excess of the cost over the selling-price.

3. Selling-price is always the cost plus the profit, or cost less the loss.

4. Commission is compensation paid by one person to another for transacting some business.

5. These business transactions are usually buying or selling property, or collecting bills.

6. The person doing business for another is called Agent, Factor, Broker, Commission Merchant.

7. The person for whom the business is done is called Principal, Employer.

8. The services performed by agents are of two kinds: *a*, Where they receive money for selling or collecting, to be remitted to their principal; *b*, Where money is sent them to be expended for their principal.

9. The agent's commission is usually some per cent of the amount collected or expended.

10. The Net Proceeds is the sum of money due the Principal after the commission and other charges have been deducted.

11. The Entire Cost of a purchase is the price paid, plus the commission and all other expenses.

12. Insurance is security against financial loss on account of the destruction of property, or by the injury or death of a person.

13. The three common forms of insurance are Fire, Accident, and Life.

14. Premium is the sum paid for insurance. In Fire insurance it is estimated at a certain per cent of the amount insured. In Life insurance it is estimated at a certain amount a year for each thousand dollars of insurance, and varies with the age of the person insured.

ORAL.

1. If 6 bbl. of flour cost $33, what will 11 bbl. cost?

2. If 9 tons of coal cost $54, how many cords of wood at $4 a cord will cost as much as 5 tons of coal?

3. $27 + 15 + 18 + 25 + 9 = ?$

4. If 4 lb. of cheese cost 36 cents, how much cheese can be bought for 3 cents?

5. If 2 bu. of cider apples cost 40 cents, what will 3 pk. cost?

6. 25% of $24 is what per cent of $200?

7. $\frac{6}{7}$ of 35 are $\frac{4}{5}$ of how many times 12?

8. How many square inches on the surface of a 6-in. cube?

9. At 6% a year what is the interest of $1,000 for 48 days? For 33 days?

10. What will 5 pints of molasses cost at $.80 a gallon?

11. How many 4-in. squares can be cut from a 20-in. square?

12. If I sold a horse for $105, and gained $16\frac{2}{3}$%, what did the horse cost?

13. How many times 4 are $\frac{4}{5}$ of $\frac{5}{6}$ of 18?

14. $\frac{7}{8}$ of 40 are $\frac{5}{6}$ of what number?

15. What per cent is lost on goods sold at $\frac{3}{4}$ of their cost? At $\frac{5}{6}$ of their cost? At $\frac{7}{8}$ of their cost? At half price?

16. What per cent of 27 is 20% of 45?

17. What is the ratio of 18 : 9? 35 : 7? 16 : 4? 5 : 15? 9 : 12?

18. 48 is the antecedent, and 8 is the consequent; what is the ratio?

19. 12 is the consequent, and 5 is the ratio; what is the antecedent?

20. To what sum will $100 amount when on interest at 6% for 2 yr. 6 mo.?

21. At 5%, for how much can I insure my store if I pay a premium of $50?

PROFIT AND LOSS.

1. I bought $640 worth of goods, and sold them at a gain of 12%. Find the selling-price.

2. An agent buys $650 worth of goods at 40% off, and sells at a gain of 25% on the cost. For what does he sell?

3. George bought a building-lot for $850, and sold it to Henry at a gain of 25%. Henry sold it at a loss of 20%; what did Henry receive for it?

4. A grocer lost 15% by selling eggs at 17 cents a dozen. Find the cost.

5. A dealer sold a horse at $12\frac{1}{2}\%$ loss, and lost $25.

6. A merchant's income is $5,760 this year. This is a gain of $18\frac{3}{4}\%$ on the capital invested. His income last year was 25% of the capital. Find his income last year.

7. If $\frac{3}{4}$ of an article is sold for $\frac{1}{2}$ of its cost, what per cent is lost?

8. A dealer lost 16% by selling goods for $4200.

9. If I sell goods that cost me $.84 a yard for $.63, what is my loss per cent?

10. If I sell a horse for $175, and gain 5%, what per cent should I have gained if I had sold him for $200?

11. I sold a farm for $5,000, and made 25%. What per cent should I have gained or lost if I had sold it for $3,500?

12. Sold flour at $7.50 a barrel, and lost $6\frac{1}{4}\%$. For what should it have been sold to gain $6\frac{1}{4}\%$?

13. Sold a lot of goods for $200, and thereby gained 25%. What per cent should I have gained had I sold them for $220?

14. A lady spent $64.50 for jewelry and dress goods, paying 15% more for dress goods than jewelry. How much did she pay for each?

NOTE. — 100% = jewelry. 115% = dress goods. 215% = both.

15. A and B together have $1,680, and A has 25% less money than B. How much has each?

INSURANCE.

1. A man insures his life for $2,500 at the rate of $22.50 for every $1,000. What is his annual premium?

2. A man insures his life for $3,000, paying $14.24 semi-annually for every $1,000. If he dies in twelve years, how much more than his premiums will his heirs receive?

3. A mill was insured for $\frac{3}{4}$ of its value. The premium paid was $350. The rate of insurance 5%. Find the value of the mill.

4. A factory valued at $50,000 is insured for $\frac{3}{5}$ of its value. The premium is $500. What is the rate of the insurance?

5. How large an insurance can I place on my house by paying a premium of $122.50, if the rate of insurance is $1\frac{3}{4}$%?

6. Find the annual rate per cent:

Sum Insured.	Premium.	Time.
$3,600	$ 60	5 years.
$4,200	$ 75	5 years.
$8,400	$315	3 years.

7. Find the amount insured:

Premium.	Rate.	Time.
$ 68.24	$\frac{4}{5}$%	1 year.
$770.00	$1\frac{1}{4}$%	3 years.
$463.40	$2\frac{1}{3}$%	2 years.

8. A ship worth $52,000 was insured for $\frac{3}{4}$ of its value at $2\frac{1}{2}$%. The cargo, worth $8,640, was insured for $\frac{2}{3}$ of its value at 3%. Find the premium.

9. A house worth $12,000 is insured for $\frac{2}{3}$ of its value. Find the premium at $\frac{3}{5}$%.

10. I insure my house worth $6,000 at $\frac{1}{2}$% on $\frac{3}{4}$ of its value, and $1,800 worth of furniture on $\frac{4}{5}$ of its value at $\frac{3}{5}$%. How much premium must I pay?

11. Mr. J. paid $250 for insurance on his stock of goods. The face of the policy is $10,000.

COMMISSION.

1. My agent bought 70 bbl. of flour at $5.25 a barrel. His commission was 3%.

2. A commission merchant sold a lot of goods for $1,480, charging 2½% commission.

3. A broker bought for me some goods for which he paid $2,146. His commission for buying was ½%. What did the goods cost me?

4. My collector charges me 3% for collecting bills. In one month I paid him $345. How much did he collect?

5. My agent sold 23 wagons at $85 each. What were the net proceeds if his commission was 6%?

6. Mr. A received $7,990 for his farm, sold by an agent. The agent asked 6% commission. What was the selling-price of the farm?

7. I collected 95% of a debt of $2,148. My commission was 3½%. What sum must I send my employer?

8. What will be the net proceeds of a sale of 525 bbl. of beef @ $18.25, allowing 3% commission and 5¢ a barrel for storing?

9. An agent bought 40 horses on commission at 4½%. If his commission was $270, what did each horse cost?

10. My agent sent $7,742.10 to me, and retained $117.90. What was the rate of his commission?

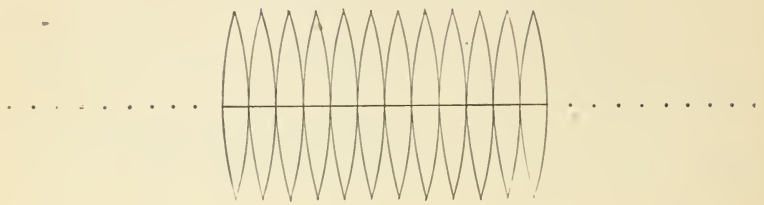
11. An agent bought some flour, paid $54½ storage, and charged $180 commission. His entire bill was $8,234½; what was the rate of commission?

12. Keeping 5% for my services, I remitted $237.50 to my employer. For how much did I sell the goods?

13.

Sale,	$4,183.36,	Rate, $3\frac{1}{3}$%;	Commission?
Sale,	$6,234.21,	Rate, $\frac{5}{6}$%;	Commission?
Sale,	$49,621.50,	Rate, $1\frac{3}{8}$%;	Commission?
Sale,	$5,369.75,	Rate, $\frac{8}{11}$%;	Commission?

TO FIND THE SURFACE OF A SPHERE.



1st Illustration. — Draw a line 6 in. long, and divide it into 12 equal parts. Make 9 dots at each extremity of the line. Take the compass, and with a radius of five in. draw arcs intersecting as in the figure. Cut out, and fold into a sphere. This is not quite exact.

2d Illustration. — Take a wooden hemisphere, and drive a tack in the center of its curved surface. Commencing at the tack, carefully wind a cord about the curved surface, as a boy winds a top. When the surface is covered, cut the cord. Drive a tack into the center of the base of the hemisphere, and wind the cord tightly about the tack. When the surface is covered, just $\frac{1}{2}$ of the string will have been used. This proves that the hemisphere is two times greater than the circle in surface. Hence the whole surface of the sphere is four times greater than the circle. How do the circumference and diameter of the circle compare with those of the sphere? How do you find the area of the circle? By what would you multiply this to get the area of the sphere?

If you multiply $\frac{1}{2}$ the circumference by $\frac{1}{2}$ of the diameter, and then multiply by 4, you will find the area of the sphere. But since $\frac{1}{2}$ times $\frac{1}{2}$ times 4 equals 1, we see that the area of the sphere is found by multiplying the circumference by the diameter.

3d Illustration. — Place a sphere on the table. Holding it between the palms of your hands, roll it over once. How long a space has been passed over? Continue until the pupil sees that it is a space as long as the circumference of the sphere. Let him next determine how wide a space has been passed over. Continue until he discovers that it is a space as wide as the distance between the hands, or the diameter of the sphere.

Lead the pupils to see that you have covered a rectangle, as long as the circumference of the sphere and as wide as the diameter. With the area of this form all are familiar.

Find the surfaces of the spheres, when the following dimensions are known:

1. Radius 5 in.
2. Diameter 8 in.
3. Circumference 31.416 ft.
4. Diameter 2 ft. 6 in.
5. Diameter $4\frac{1}{2}$ ft.
6. Radius 6 in.
7. Diameter 12 ft.
8. Circumference 62.832 in.
9. Radius $5\frac{1}{2}$ ft.
10. How much leather will it take to cover a base-ball if its diameter is $3\frac{1}{2}$ inches?
11. At 15¢ a square foot, what will it cost to gild a sphere 14 in. in diameter?

COMMERCIAL DISCOUNT.

Commercial discount is a reduction from the nominal price of anything.

1. Find the net amount of a bill of $1,440, with 25%, 10%, and 5% off.

25% of $1,440 =	$ 360.00
$1,440 − $360 =	1080.00
10% of $1080 =	108.00
$1080 − $108 =	972.00
5% of $972 =	48.60
$972 − $48.60 =	923.40. *Ans.*

$1,440 is the gross amount of the bill.

Find 25% of this amount and deduct it. The result is $1,080. Find 10% of this amount and deduct it. The result is $972. Find 5% of this amount and deduct it. The result is $923.40. This is the net amount of the bill.

2. Find the net amount of a bill of $1,920 with 25% and 7½% off.

Find the net amount of a bill of:

3. $1,275 with 20% and 15% off.

4. $562 with 35% and 15% off.

5. $1,088 with 50% and 10% off, and an additional 5% off for cash.

6. 8 doz. bolts, at $3.00 with 40%, 5%, and 25% off.

7. 11 gross screws, at $2.25, with ⅔, and 30% off.

8. 6 doz. handles, at $1.50, with 40%, 5%, 25%, and 17½% off.

9. 480 lb. tea, at 62½¢, with 37½%, and 15% off.

10. 560 articles at 87½¢, with 25%, 16⅔%, and 10% off.

11. 25 lb. crushed sugar, at 10¢; 40 lb. maple sugar, at 12¢; 6 lb. cheese, at 13¢; 8 lb. butter, at 28¢; 4 lb. raisins, at 13¢; 2 lb. cream tartar, at 35¢; with 15%, 20%, and 5% off on the whole.

12. 20 oxen, at $53.50, with 45%, 15%, and 5% off.

13. 15 cows, at $23.25, with 25%, 15%, and 10% off.

14. 15 reams note paper, at $1.25, and 25 reams letter paper, at $1.75 with 30%, 22½%, and 12½% off.

PERCENTAGE.

1. I bought books listed at $12 a dozen for ½ and 10% off. I sold them at $1.00 each. What per cent did I gain?

2. A farmer sold 1,000 bu. of corn at $1 a bushel, and estimated his loss at 5%. What per cent would he have gained had he sold at $1.20 a bushel?

3. A dealer sold skates at $3.60 a pair, and made 20%. What per cent would he have made if he had sold them at $4.00 a pair?

4. Find the net gain on two houses sold for $2,100 each, if on one there is a gain of $16\frac{2}{3}\%$ and on the other a loss of $12\frac{1}{2}\%$.

5. A house was insured for $\frac{3}{4}$ of its value at $\frac{3}{4}\%$. The premium was $13.50. What was the value of the house?

6. A real-estate dealer sold for me 75 lots of land at $275 a lot. If he charged me 2% commission for selling, and $5 a lot for recording the deed, how much will I receive for all my land?

7. A merchant sold 73,680 ft. of lumber at $20 per M., and gained $294.72. What was his per cent of gain?

8. By selling a piece of land for $160, I lost 25%. At what price should I have sold it to have made 20%?

9. I bought a house for $2,250, and sold it for $2,700. What per cent did I gain?

10. A dealer bought 56 house-lots for $256.00 each, and sold them at an advance of $9\frac{3}{4}\%$. How much did he receive for all the lots?

11. A merchant paid $18\frac{3}{4}¢$ a yard for cloth, and exchanged $12\frac{1}{2}$ yd. for 16 doz. eggs at 25¢ a dozen. What per cent of profit did he make?

12. By selling a piece of land for $16\frac{2}{3}\%$ profit I cleared $150. What did it cost?

13. If I pay $150 for insuring $8,000 worth of goods, what is the rate?

1. What will it cost to make a road 104 rd. long and 99 ft. wide, if the land costs $154 an acre, and the grading $200 a mile, and fencing 50¢ a yard?

2. Divide $336 between two persons so that one may have $\frac{7}{5}$ as much as the other.

3. An agent charged $25.50 as commission at $2\frac{1}{2}\%$ for selling 200 bbl. of flour. At what price a barrel was the flour sold?

4. The circumference of a circle is 15,708 ft. Find the radius. The radius of a circle is 42 ft. What is its circumference?

5. What is the interest on $500 for 3 yr. 7 mo. 18 da. at 6%?

6. Change $\frac{1}{1\frac{1}{4}}$ of a mile to rods, yards, etc.

7. How much is $5\frac{4}{5}$ tons of coal worth if $17\frac{2}{3}$ tons are worth $100?

8. If the numerator of a common fraction is divided by 3, what is the effect upon the value of the fraction? Illustrate it.

9. Two men start from two towns 105 miles apart, and walk toward each other. They meet at the end of 15 hours. If the first traveled 3 miles an hour, how many miles did the second travel an hour?

10. A can do $\frac{1}{3}$ of a piece of work in 4 days, and B $\frac{1}{4}$ of it in 5 days. In what time can they do the whole, working together?

11. A man desires to secure an annual income of $650 for his daughter. How much money must he put on interest at 5% to do it?

12. A circular fountain has a radius of 10 ft. Outside of this is a walk 5 ft. wide. How many square yards in the walk?

13. A young man inherited some money. He spent $\frac{1}{4}$ of it in 3 mo., and $\frac{3}{7}$ of the remainder in 10 mo., when he had $2,526 left.

14. Find the volume of a cone whose altitude is 18 yd., circumference of base 25.1328 yd.

1. Reduce $\frac{4}{5}$ of a mile to rods.

2. A tank 18 ft. long and 15 ft. wide requires 96 sq. yd. of lead to line its sides and bottom. How deep is it?

3. A room 20 ft. long, 17 ft. 6 in. wide, will require how many yards of carpet 2 ft. 6 in. wide to cover it, if no allowance be made for waste?

4. Find the area of a gravel walk 6 ft. wide just inside a fence surrounding a lot 320 ft. long, 210 ft. wide.

NOTE. — Find area of one rectangle 320 by 210 ft., and of another 308 by 198 ft. Find their difference.

5. What is the difference between 65 divided by .65, and .65 divided by 65?

6. By selling a carriage for $117 a dealer lost 10%. For how much should he have sold it to gain 10%?

7. A man gave $\frac{2}{3}$ of his money to his wife, $\frac{2}{3}$ of the remainder to his oldest daughter, and the remainder, $5,000, he divided equally between his two younger daughters. How much was the man worth?

8. Add seven hundredths, thirty-six ten-thousandths, and seventy-two millionths.

9. Change .1875 bu. to quarts.

10. Reduce 1,674 ft. to rods; 7,481 in. to rods.

11. I paid $25 for an insurance policy on my house. If the rate is $\frac{1}{2}$%, for how much is my house insured?

12. I collected 80% of a debt of $5,600, and charged $4\frac{1}{2}$% commission. How much ought I to return to my employer?

13. A man spent $\frac{8}{21}$ of his money, and invested $\frac{4}{5}$ in business. He had the rest, $1,850, in a bank. How much was he worth at first?

14. Find the interest on $769.74 for 3 yr. 9mo. 17 da. at 4%.

15. Find the amount of $639.80 from July 25, 1898, to Jan. 6, 1901, at $7\frac{1}{2}$%.

16. $2,300 is 15% more than what?

1. The selling-price is $73.50, the discount 30% and 30%. find the list-price.

2. If one of my carriage-wheels is 4 ft. in diameter, how many miles, rods, etc., has been traveled when it has made 636 revolutions?

3. Write a proportion. State two principles of proportion, and by them test your proportion.

4. Solve by proportion and write explanation: If 5 men can do a piece of work in 13 days, in how many days can 65 men do it?

5. The area of a trapezoid is 32,400 sq. yd.; the two parallel sides are 124 yd. and 200 yd. Find the altitude.

6. The area of a trapezoid is 280 sq. rd. One of the parallel sides is 20 rd., and the perpendicular is 14 rd. Find the other parallel side.

7. If 100% is gained by selling an article for 50 cents, how much would be gained by selling it for $1.50?

8. If a train runs 48 miles in 1 hr. 20 min., how long will it take it to run 220 miles?

9. Two men have each $3,000. One man loans $2,000 at 5%, and the remainder at 4%. At what per cent must the other man loan his money to receive the same income?

10. Add $\frac{5}{7}$, $\frac{2}{3}$, $\frac{4}{5}$. $\frac{5}{8}$, $\frac{3}{4}$, $1\frac{7}{2}$, $\frac{3}{6}$.

11. My father pays $150 premium. If his house is insured at $1\frac{1}{2}$% for $\frac{2}{3}$ of its value, what is his house worth?

12. An ocean steamer cost $1,550,000. What premium must be paid to insure it at $2\frac{1}{4}$%?

13. Multiply $6{,}789\frac{4}{7}$ by 5,087.

14. Divide 65,281,071 by 789.

15. At $4.50 a cord, find the cost of a pile of wood 8 ft. long, 4 ft. wide, and 5 ft. high.

16. Required the cost of laying a pavement $5\frac{1}{3}$ rd. by 8 ft. 6 in. at $1.65 a square yard.

ORAL.

1. $\frac{1}{5}$ of 20 are $\frac{2}{3}$ of what number? $\frac{5}{8}$ of what? $\frac{4}{7}$ of what?

2. When oranges cost 25¢ a dozen, how many can be bought for $66\frac{2}{3}\%$ of \$2.25? For 50% of \$1.25? For 3 times $16\frac{2}{3}$ cents?

3. Charles is 12 years old. $\frac{2}{3}$ of Charles's age is $\frac{4}{5}$ of Bessie's. $\frac{5}{6}$ of Charles's age is $\frac{3}{5}$ of George's age. How old are Bessie and George?

4. What is the cost of 54 yd. of cloth at $\$0.16\frac{2}{3}$ a yard?

5. What per cent of 100 is 25% of 80? $66\frac{2}{3}\%$ of 75?

6. What per cent of 80 is 25% of 100? $66\frac{2}{3}\%$ of 75?

7. Find the cost of tea a pound when 10% is gained by selling it at 55¢ a pound?

8. A teacher said, "I should have 50 pupils in my room, but 5% are absent." How do you know she made a mistake?

9. At 6% find the interest for 12 days:

\$3000	\$840	\$30	\$ 1500
3500	620	10	2400
1200	150	15	10000

10. A ship worth \$60,000 was insured at 4%. What was the premium?

11. A bill of goods amounting to \$500 I bought at a discount of 10%. What did I pay?

12. If 36 is the antecedent and 3 is the ratio, what is the consequent?

13. What is the area of a triangle whose base is 24 ft. and altitude 8 ft.?

14. If the area of a triangle is 48 sq. ft. and the altitude is 8 ft., what is the base?

15. If the area of a rectangular field is 77 sq. rd. and the base is 11 rods, what is the altitude?

16. How many board feet in a plank 20 ft. long, 15 in. wide, and 2 in. thick?

1. Sold 96 yd. of carpeting at $\$1.87\frac{1}{2}$ a yard, and thereby gained \$38.40. How much did it cost me a yard?

2. What would you gain by selling at $6\frac{1}{4}¢$ a pound, 1,522 lb. of rice costing \$4.25 a hundred, and 636 lb. of barley costing \$5.60 a hundred?

3. Multiply seventy-eight ten-thousandths by five hundredths; divide the product by thirteen thousandths, and reduce the quotient to a common fraction.

4. A commission merchant sold 500 pieces of cloth for \$130 a piece, and paid his employer \$55,250. What was the rate of his commission?

5. At what rate per cent must I invest \$600 that in 2 yr. 6 mo. it may amount to \$705?

6. The ratio is $3\frac{1}{2}$; the antecedent $\frac{1}{2}$ of $\frac{5}{8}$; what is the consequent?

7. A dealer bought a horse for \$125, and sold it for 20% advance; sold a carriage for \$125, gaining 25%; sold another carriage for \$125, losing 20%; bought a horse for \$125, and sold it at a loss of 25%. Find his whole gain or loss.

8. What is the area in acres of a triangle whose base is 56 rd. and altitude 63 rd.?

9. How many farms containing 90 acres each can be formed in the town of Granby, if it is in the form of a rectangle 6 miles long and $4\frac{1}{2}$ miles wide?

10. A man marks his goods at 25% above cost, and deducts 12% of the amount of every bill of goods sold. What per cent does he make?

11. What is a fraction? Explain addition of fractions, and give the reason for every step.

12. What is interest? Explain your method of finding the interest on any sum for any time at any rate.

13. From four billion take two billion, one hundred five million, two hundred fifty thousand, forty-seven.

1. What will be the cost of paving and curbing a street $\frac{3}{4}$ of a mile long and 42 ft. wide, if the paving costs $1.25 a square yard, and the curbing 45¢ a linear foot?

2. If 1 cd. of wood costs 4\frac{3}{4}$, what will be the cost of 5 loads of $\frac{7}{8}$ cd. each, 6 loads of $\frac{3}{4}$ cd. each, and 9 loads of $\frac{2}{3}$ cd. each?

3. At $45 an acre, find the value of a piece of land 60 rd. long, 40 rd. wide at one end, and 30 rd. wide at the other.

4. How many bushels in a conical heap of grain the base of which is 9 ft. in diameter and the altitude 5 ft.?

5. How many feet of lumber will be required to make pickets for a fence 3 ft. high round a lot 22 rd. long and 18 rd. wide, each side to begin and end with a picket. The width of the pickets is to be 4 in., and the space between them 4 in.

6. How many acres in a semicircular field whose radius is 80 rd.?

7. Find the volume of a square pyramid whose base is 5 ft. and altitude $10\frac{1}{2}$ ft.

8. The fore-wheels of a carriage are $10\frac{1}{2}$ ft. in circumference and the hind-wheels 14 ft. How many more revolutions will one make than the other in going $\frac{1}{2}$ mile?

9. How many yards of silk $\frac{3}{8}$ of a yard wide will it take to line $7\frac{1}{8}$ yd. of cloth $1\frac{3}{8}$ yd. wide?

10. A man's yearly expenses are $1,200. 75% of his expenses is $33\frac{1}{3}$% of 50% of his income.

11. By selling hay at $15 a ton I gain 20%. What per cent should I gain by selling it at $13.50 a ton?

12. A tank 8 ft. deep, 14 ft. long, and $7\frac{1}{3}$ ft. wide is $\frac{2}{3}$ full of water. At the rate of 5 gal. a minute, how long will it take to pump out the water?

13. What is the width of a pile of wood 64 ft. long, 10 ft. high, if it contains 20 cords?

14. If $1\frac{1}{8}$ yd. cost $$1\frac{3}{4}$$, what will 81 yd. cost?

ALGEBRAIC SYMBOLS.

1. Charles and Henry together had 72 cents. If Charles had 3 times as many as Henry, how many did each have?

2. Three men, A, B, and C, formed a company with a capital of $8,000. B put in 4 times as much as A, and C three times as much as A. How many dollars did each put in?

3. The sum of two numbers is 99, and the greater is twice the less. What are the numbers?

4. Three times a certain number added to two times the same number gives 75. Find the number?

5. The sum of two numbers is 366, and the greater is 5 times the less. What are the two numbers?

6. A man bequeathed $48,000 to his wife, son, and daughter. The will provided that the son should receive twice as much as the daughter, and the wife 3 times as much as the daughter. What was the share of each?

7. A man divided 80 cents between two children. If he gave the second three times as much as the first, what did he give to each?

8. Divide the number 88 into three parts, so that the second part shall be three times the first, and the third four times the first.

9. Divide the number 120 into three parts so that the second part shall be two times the first, and the third part as much as the sum of the first and second.

10. Four men have together $480. B has 4 times as much as A, C has 6 times as much as B, and D has $\frac{1}{8}$ as much as C. How many dollars has each?

11. A boy, being asked how many marbles he had, said that if he had 5 times as many more he should have 240. How many had he?

12. In a school there are 495 pupils, and twice as many boys as girls. How many boys are there?

1. If a number is multiplied by 8, the product is 480. What is the number?

2. A farmer sold a horse and cow for $240. He sold the horse for five times as much as the cow. How much did he get for each?

3. Find the cost of insuring a house for $4,000 at 60¢ on a thousand, and furniture for $12,000 at 80¢ on a thousand, less 15% on both premiums.

4. What was paid for insuring a cargo of merchandise for $8,720 at ¾% less 22%?

5. What principal will amount to $6525.15 in 4 yr. 7 mo. 6 da. at 5%?

6. What principal will gain $11.60 in 8 mo. 21 da. at 4%?

7. At what rate will $525 produce $30.975 interest in 1 yr. 11 mo. 18 days?

8. Find the interest on $600 from Aug. 16 to Nov. 24 at 7½%.

9. Find the net amount of the following bills: $61.51, discount 60% and 5%; $18.75, discount 10%; $16.86, discount 12½%; $44.25, discount 40% and 5%; $29.60, discount, 40%, 12½%, and 10%; $28.04, discount 55%; $18, discount 65%, 10%, and 10%; $307.55, discount 25% and 12½%; $36.61, discount 40% and 10%.

10. Find single discounts equivalent to the following: 15% and 10%; 45% and 10%; 20% and 12½%; 60% and 10%; 75% and 12½%.

11. If by selling tea at 47½¢ a pound I lose 5%, at what price must I sell it to gain 15%?

12. Find the per cent of loss on goods sold at $883.05 and bought at $1015.

13. $206.25 was the premium paid for insuring a factory at 1⅜%.

14. What is the amount of $315 for 3 yr. 7 mo. at 8%?

MEASUREMENTS.

Make accurate drawings to represent the examples in this lesson. Find the answers by measuring.

1. Two men, Brooks and Scott, start from A. Brooks walks directly north 36 miles, and Scott directly east 48 miles; how far apart are they in the shortest line? Scale, $\frac{1}{1}\frac{1}{2}$ in. to a mile.

2. A house is 18 ft. wide. From the attic-floor to the ridge-pole it is 12 ft. How long rafters must be used to project 6 in. over the wall of the house? Scale, $\frac{1}{2}$ in. to 3 ft.

3. If the length of this roof is 32 ft., how many boards 16 ft. long and 6 in. wide will it take to cover it?

4. At a point, A, draw a line east 6 in. to B; south 2 in. to C; west 2 in. to D; south 1 in. to E; west 1 in. to H; south 4 in. to I; west to a point directly south of A to J. Connect A and J. How far is it round this field? Scale, $\frac{1}{4}$ in. to a rod.

5. From B to H is what part of the whole distance?

6. $\frac{5}{8}$ of the distance round this figure is how many yards?

7. The distance from A to C is what part of the distance from C to J?

8. The distance between any two letters is what part of the whole distance?

9. Three boys were standing by a tree. William remained there; George and Henry walked east 24 ft. to another tree. George stopped there, and Henry walked north 32 ft. to another tree and stopped. How far is Henry from William? Scale, 1 in. to 8 ft.

10. Beginning at the north-east corner, the boundary-line of my lot runs as follows: west 40 rd. to a tree, called B; south 16 rd. to a point, C; east 24 rd. to another tree, called D; then north-east to the point of beginning. How many square rods in the lot? How many rods round the field? Scale, 1 in. to 8 rd.

FRACTIONS.

1. If $\frac{3}{5}$ yd. of cloth cost $\$\frac{9}{16}$, what will $\frac{8}{15}$ of a yard cost?

2. Make out the following bill, supplying names and dates: 32 lb. soap, @ $15\frac{1}{8}¢$; 35 lb. starch, @ $5\frac{3}{4}¢$; 85 lb. sugar, @ $8\frac{1}{3}¢$; $62\frac{1}{2}$ gal. of vinegar, @ $25¢$; 28 lb. coffee, @ $23¢$; 112 lb. butter, @ $33\frac{1}{2}¢$. Discounts, 10% and 5%.

3. A merchant bought 76.75 yd. of cloth for $\$115\frac{1}{8}$, and sold $\frac{1}{5}$ of it at an advance of $\$\frac{1}{4}$ a yard. How much did he receive for the part sold?

4. What will 76 lemons cost if three dozen cost $\$1\frac{1}{8}$?

5. What will 8 lb. 12 oz. of butter cost, if $1\frac{1}{2}$ lb. cost 30 cents?

6. When $2\frac{1}{5}$ tons of hay cost \$33, what will $18\frac{3}{5}$ tons cost?

7. If $3\frac{1}{3}$ yd. of cloth cost \$10, what will $2\frac{2}{3}$ yd. cost?

8. A man sold a horse for $\$125\frac{3}{4}$ and gained $\$26\frac{1}{8}$. How much did the horse cost?

9. A man divided 6.3 bu. of potatoes among his workmen, giving each $\frac{3}{10}$ of a bushel.

10. What is a complex fraction? Write one. Change it to a simple fraction.

11. What is a mixed number? Write one. To what other form can you change it? Do so. Have you changed its value?

12. What are the terms of a fraction called? Why are they so called?

13. Show what effect it has upon the value of a fraction to (1) multiply its numerator by 2; (2) to divide its denominator by 2; (3) to multiply both numerator and denominator by 2; (4) to multiply its numerator by 2, and divide its denominator by 2.

14. At $7\frac{1}{2}¢$ a pound, how many pounds of sugar can you buy for \$4.80?

15. How many feet in $5\frac{3}{3}$ rd. and $4\frac{1}{6}$ yd.?

16. What fraction of $4\frac{1}{2}$ is $6\frac{2}{3}$?

MEASUREMENTS.

1. What will it cost to dig a cellar 70 ft. long, 35 ft. wide, 5 ft. deep, at 62½¢ a cubic yard?

2. At $4.25 a cord, what is the value of a pile of wood 72 ft. long, 4 ft. wide, and 12 ft. high?

3. At $18 per M. find the cost of planks for flooring a barn 40 ft. by 32 ft., if each plank is 16 ft. long, 15 in. wide, 2 in. thick?

4. The width of a gable is 30 ft. and its perpendicular height 20 ft. What will be the cost of boarding two gables at $16 per M.?

5. A bin is 8.5 ft. long, 4.25 ft. wide, and 3.75 ft. deep. How many bushels of oats will it hold?

6. How many gallons of water will a tank hold 4 ft. by 3¾ ft. by 2 ft. 4 in.?

7. A rectangular garden is 200 ft. long and 150 ft. wide. There is a walk 4 ft. wide running all round it, and also through the center in both directions. What part of the whole area of the garden is taken up with the walk?

8. A section of land is one mile square. At 60¢ a rod for fencing, and $1¾ an acre for plowing, find the sum paid out for a quarter-section of land.

9. A room is 18 ft. by 24 ft. A carpet is ¾ of a yard wide, and runs lengthwise. There is a waste of 9 in. on each breadth for matching. At $1.25 a yard find the cost of the carpet.

10. What will it cost to build a fence round a square 660 ft. on a side, if the posts are placed 6 ft. apart, and cost 18¢ each? The pickets are 2 in. wide, and placed 2 in. apart, and cost $3.25 a hundred. The two rails are 4 in. by 4 in., costing $12 per M. board feet. The labor is $125.

11. At $72 an acre, a farm is worth $12,240. What will it cost to fence it at $1.25 a rod if it is in the form of a rectangle 160 rd. wide?

1. A house worth $3,500 is insured for $\frac{4}{5}$ of its value at $\frac{3}{4}\%$.

2. A man paid $87 for insuring his house, worth $7,250. What was the rate of insurance?

3. If I pay $27 for insuring property at $\frac{3}{5}\%$ premium, what is the value of the property?

4. I insured my barn for $\frac{3}{4}$ of its value at $1\frac{1}{4}\%$, and paid a premium of $15.

5. A merchant imported 175 chests of tea. Each chest contained 45 lb., valued at 48¢ a pound. He sold it at a gain of 25%. Find the selling-price.

6. An elevator in Minneapolis is valued at $24,000, and the grain in it at $25,000. The elevator is insured for $\frac{5}{8}$ of its value at $\frac{3}{4}\%$, and the grain is insured for $\frac{4}{5}$ of its value at $\frac{1}{2}\%$. Find the entire premium.

7. The perimeter of a rectangle is 42 inches. The horizontal sides are twice as long as the vertical sides. How long is each side?

8. A earns 18% more in a week than B, and the sum of their wages is $76.30. How much does each earn?

9. A merchant paid $1.50 for a book, and marked it to be sold for $2.00. He discounted $12\frac{1}{2}\%$ from his price. How much did he gain?

10. An agent purchased $4\frac{1}{2}$ tons of raw sugar at $3\frac{1}{2}$¢ a pound. What was his commission at $2\frac{1}{2}\%$?

11. The net proceeds of a sale were $1,368. The commission was $57. What was the rate of commission?

12. Find the interest of $586 for 3 yr. at 7%.

13. Find the interest of $1,264 for 4 yr. 6 mo. @ 5%.

14. Find the interest of $2,862 for 93 days @ 6%.

15. Divide 96,496 by 592; 76,368 by 516.

16. Add .96, 7.3004, 8010, .00093, 1.24650.

17. From 10.1010 take 1.0999.

18. From 81.0047 take 7.008246.

1. What sum of money put at interest at 6% for 10 mo. 11 da. will amount to $6,311?

2. Find the rate when the interest of $1,268 for 2 yr. 9 mo. 18 da. is $266.28.

3. In what time will $750 produce $88.75 interest at 5%?

4. At what rate will $1,400 produce $315 interest in 3 yr. 9 mo.?

5. I lost $1,280 on 160 acres of land, which I sold for $34 an acre.

6. A commission merchant sold 4,500 doz. oranges at 32¢ a dozen. After deducting $27.40 for freight, and $15 for storage, and his commission, he remitted $1,340 to his employer. What was the rate of his commission?

7. If I pay $428.80 for the use of $1,280 for 4 yr. 5 mo. 18 da., what is the rate per annum?

8. Find the net amount of a bill of $1,875, the discounts being 20% and 5%?

9. At a discount of 15% the net amount of a bill was $552.50. What was the face of the bill?

10. Find the net amount of a bill of $1,285, the discount being $\frac{1}{3}$ and 5% for cash.

11. A bill of goods at list price amounted to $750. The net price amounted to $625. What was the per cent of discount?

12. Which would you rather have, a discount of 40% and 10%, or a discount of 30% and 20%, on a bill of $1,826? What would be the difference?

13. Four thousand barrels of flour were insured for $14,400, which was $\frac{4}{5}$ of its value. The premium was $180. Find the rate.

14. Find the entire surface of a cone the diameter of whose base is 3 ft., and whose slant height is 12 ft.

15. If a man can build .35 of a rod of wall in an hour, how many rods will 6 men build in 4.6 days, working 8.5 hours a day?

ORAL.

1. A house valued at $800 was insured for three years at 1¼%. What was the premium?

2. A man sold a horse and carriage at a loss of 20%. If he received $240, what was the cost?

3. A dealer sold a set of books for $25, and gained 25%. What per cent would he have gained or lost if he had sold for $21?

4. By selling a carriage for $180, a man gained 20%. Find the cost.

5. At $1.25 a rod, find the cost of building a wall one mile long.

6. A man sold a cow for $60, which was ¾ of the cost. How much did he lose?

7. Make an example like the 6th, using per cent.

8. If your steps are each 2 ft. long, how many steps will you take in walking 2 rd. 1 yd.?

9. How many surface feet in a rectangular piece of marble 4 ft. long, 3 ft. wide, and 2 ft. thick?

10. Find the commission that an agent receives for selling 40 bbl. of flour at $6 a barrel, if he receives 3%.

11. A bookseller bought a book for $3.75, and sold it for $4.50. What per cent did he make?

12. How many acres in a field 80 rd. long and 40 rd. wide?

13. How many cords in a pile of wood, 32 ft. long, 4 ft. high, and 4 ft. wide?

14. At $1.25 a cubic foot, find the cost of a block of granite 4 ft. long, 3 ft. wide, and 2.5 ft. thick.

15. At $1 a hundred board feet, find the cost of 6 boards, each 12 ft. long, 10 in. wide.

16. At 20¢ a square yard, what will it cost to paint a ceiling 18 ft. by 24 ft.?

17. If ⅓ of a yard of cloth cost $8, what will 2½ yd. cost?

MEASUREMENTS.

1. What is the circumference of the largest circle that can be drawn on a 9 ft. square?

2. If it requires 440 ft. of lumber to board up the gable ends of a barn 40 ft. wide, how high is the ridge above the eaves?

3. The area of a triangle is 36 sq. yd., and the base is 36 ft. What is the altitude?

4. Find the convex surface of an equilateral triangular pyramid, the sides of whose base are each 8 ft., and whose slant height is 24 ft.

5. How long a band of iron will it take to surround a cylindrical tank 15 ft. 8 in. in diameter?

6. What is the area of a semicircle whose radius is 24 inches?

7. At $1.25 a square yard, how much will it cost to pave a triangular space, one of whose sides is 80 yd., and the perpendicular distance from the opposite vertex to that side 180 feet?

8. The diagonal of a trapezium is 18 ft., and the perpendiculars from the opposite vertices are 9 ft. and 8 ft. respectively. What is the area?

9. Find the convex surface of a cone, the radius of whose base is 16 in., and whose slant height is 8 ft.

10. At 25¢ a square yard, it costs $18.75 to paint a triangular surface. If the base is 60 ft., what is the altitude?

11. How many acres are there in a field in the form of a trapezoid, if the parallel sides are 24 rd. and 16 rd., and the distance between them 18 rd.?

12. What is the surface of a sphere whose circumference is 24 ft.?

13. If a bin is 8 ft. square, how deep must it be to hold 256 bu. of apples?

14. A field in the form of a trapezoid contains $11\frac{1}{4}$ acres. If the parallel sides are 60 and 40 rd., how far apart are they?

1. A certain number added to 7 times itself equals 64. What is the number?

2. Reduce $2\frac{1}{4}$ to 24ths.

3. A company of 300 persons consists of men, women, and children. There are two times as many children as men, and three times as many women as men. How many are there of each?

4. A tank was $\frac{2}{3}$ full of oil; then 44 gal. were drawn out. If it was then $\frac{2}{5}$ full, how many gallons were in it at first?

5. At 15¢ a square rod, what will it cost to cover with gravel a driveway $49\frac{1}{2}$ ft. wide round the outside of a circular park 36 rd. in diameter?

6. Required the convex surface of a triangular pyramid, the sides of whose base are 20 ft., 25 ft., and 30 ft., and the slant height 65 ft.

7. A stand-pipe is 30 ft. in diameter, and 80 ft. high. How many square feet of sheet iron did it take to make it? How much will it cost to paint it at 28¢ a square yard?

8. How many feet in a board 18 ft. long, 16 in. wide at one end and 18 in. at the other?

9. Divide 675 into two parts so that one part shall be $\frac{2}{3}$ of the other.

10. If $6\frac{1}{2}$ cd. of wood cost \$28.60, how much can be bought for \$514.80?

11. What is the ratio of:

32 : 8?	48 : 16?	3 bu. : 3 pk.?
24 : 6?	24 ft. : 6 in.?	12 gal. : 2 qt.?
6 : 24?	1 qt. : 1 bu.?	$\frac{7}{8} : \frac{5}{24}$?

12. If I pay a premium of \$51.75 for insuring $\frac{2}{3}$ of my house at $2\frac{1}{4}\%$, what is the value of the house?

13. In what time will \$212 at 6% gain \$27.984 interest?

14. On what principal will the interest for 7 yr. 7 mo. 24 da. be \$172.125 at 6%?

1. An agent charged $295.80 commission, and $43.20 expenses, for selling a lot of goods. He sent the owner $14,451. What was the rate of his commission?

2. What is the commission at 2½% on a sale of 676 bbl. of flour at $5.50 a barrel?

3. An agent sold 165 bales of cotton, each bale weighing 380 lb., at 13¢ a pound, on a commission of 3¼%. What was his commission?

4. The list-price of a bill of goods amounts to $1,672; the discounts are 30%, 10%, and 5%. What is due on this bill?

5. John and Henry together have 57 cents. If John has 2 times as many as Henry, how many has each?

6. I gain 20% by selling property for $900. What per cent shall I gain or lose by selling it for $650?

7. Selling-price, $63; rate of loss, 12½%; find the cost.

8. A man drew out 33⅓% of all his deposits. He spent 62½% of all he drew out for a tandem bicycle at $125. What was his original deposit? What per cent of his original deposit did he spend?

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9. Property that cost $320 increased in value to $360. What was the per cent of increase?

10. An agent received $30 at the rate of ⅝% for selling some property.

11. 80% of ⅝ of a farm is what per cent of the whole farm?

12. 25% of ⅔ of a farm is what per cent of ¾ of it?

13. A bushel of wheat makes 40 lb. of flour. A bin is 10 ft. long, 8 ft. wide, and 6½ ft. deep. If it is ¾ full of wheat, how many barrels of flour will the wheat make?

14. How many board feet in 14 planks 15 ft. long, 16 in. wide, and 6 in. thick?

15. What will it cost to carpet a room 27½ ft. by 18 ft. with carpet 27 in. wide, at $1.12½¢ a yard? The breadths run lengthwise, and there is a loss of 14 in. on each breadth for matching.

1. Find the volume of the following solids:
3 yd. x 1½ yd. x 2 ft.; 5 yd. x 1½ yd. x 3 ft.
6 ft. 3 in. x 3 ft. 3 in. x 2 ft. 6 in.

2. There are 360 persons in a room 60 ft. long by 40 ft. wide. To allow 100 cubic feet of air for each person, how high ought the room to be?

3. A river overflowed its bank, and flooded a tract of land 20 miles long, ¾ of a mile wide, to a depth of 4 ft. If a cubic foot of water weighs 62½ lb., what was the weight of the water on the tract?

4. A lawn-tennis court is 78 ft. long and 27 ft. wide. At each end there is a margin of grass 12 ft. wide, and at each side a margin 6 ft. wide. It costs 50¢ a square yard to turf the margin, and 35¢ a square yard to gravel the court. Find the entire cost.

5. At 27¢ a square yard find the cost of plastering a room 22 ft. 3 in. long, 17 ft. 9 in. wide, and 12 ft. 6 in. high. There are two windows, each 5 ft. 3 in by 3 ft. 4 in.; a door 7 ft. by 3 ft. 9 in.; a fireplace 5 ft. 3 in. by 4 ft. 4 in., and a base-board 9 in. high.

6. A rectangle 150 ft. by 120 ft. has in the center a rectangular grass-plot 80 ft. by 60 ft. Cover the rest with gravel 8 in. deep at a cost of 62¢ a cubic yard.

Find the ratios of:

7. A square 3 ft. long : a square 2 ft. long.

8. A cube 4 in. long : a cube 2 in. long.

9. A circle 6 in. in diameter : a circle 2 in. in diameter.

10. A square : a square half as long.

11. A square : a square twice as long.

12. A square : a square ⅓ as long.

13. A cube : a cube half as long.

14. A man walked 12 miles in 3 hours. At the same rate how far could he walk in 1¼ hours?

1. A tank can be filled by one pipe in 15 min., and by another pipe in 30 min. In what time can it be filled by both together?

2. Suppose water runs in through the first pipe and out through the other. In what time then will the tank be filled?

3. A cistern can be filled by one pipe in half an hour, by a second pipe in 45 min., and by a third pipe in an hour. In what time will the cistern be filled if all run together?

4. Suppose water runs out through the second pipe and in through the other two. In what time then will it be filled?

5. The population of a certain town was 35,416 in 1890. If it increases 50% in 10 years, what will it be in 1900?

6. Find the gain or loss per cent:

Cost, \$20; selling-price, \$25.
Cost, \$2.00; selling-price, \$2.12½.
Cost, \$12.40; selling-price, \$10.23.
Cost, \$74.00; selling-price, \$70.30.

7. A house is sold for \$400, and 25% is made. How much profit would be made by selling for \$336?

8. By selling a house for \$7,590 a man gained 10%. What per cent would he have lost if he had sold it for \$6,210?

9. A draper bought 960 yd. of silk at \$2.00 a yard. He sold ¼ at a gain of 25%, ⅓ at a gain of 20%, and the remainder at a loss of 15%. For what was it sold?

What is paid for goods marked:

10. \$600, with a discount of 33⅓%?

11. \$1,200, with a discount of 16⅔%?

12. \$1,000, with a discount of 27% and 10%?

13. \$600, with discounts of 20%, 10%, and 1%?

14. \$2,500, with discounts of 20%, 5%, and 1½%?

15. Which is cheaper, to buy goods at a discount of 30% and 5%, or with 33⅓% off? How much cheaper on a bill of \$600?

What is the marked price of goods sold for:

1. \$94.50 after a discount of 30% and 10%?

2. \$98 after a discount of $12\frac{1}{2}\%$ and $12\frac{1}{2}\%$?

3. \$135 after a discount of $16\frac{2}{3}\%$ and 10%?

4. Find what was received for goods marked \$3,600 if a discount of $\frac{1}{4}$ and 15% is allowed.

5. Goods marked \$64 were sold at $6\frac{1}{4}\%$ discount and 5% for cash. What was the selling-price?

6. A tree 45 ft. high was broken at such a point that the part broken off was 4 times the length of the part left standing. Find the length of each part.

7. After deducting his commission of 5%, an agent returned to his employer \$1,436.40.

8. A commission merchant sells goods for \$5,728, and sends to his principal \$5,649.24. What was his per cent of commission?

9. A company insured a mill and its machinery for \$117,944, the machinery being worth 15% of the value of the mill. The owner paid 2% on the mill, and $1\frac{1}{2}\%$ on the machinery. Find the total premium.

10. Find the interest on \$468.93 at $4\frac{1}{2}\%$ for 5 yr. 9 mo. 18 da.

11. Find the interest on \$1,680.50 at 4%, for 3 yr. 6 mo. 27 days.

12. Find the amount of \$2,500 at $5\frac{1}{2}\%$ for 3 yr. 11 mo. 6 da.

13. Find the amount of \$155 at $3\frac{1}{2}\%$ for 1 yr. 3 mo. 3 days.

14. Simplify: $4\frac{1}{2} + \frac{1}{3} - 3\frac{3}{4} + 5\frac{1}{8} - 6\frac{1}{16}$.

15. What is the greatest number that will divide 2,000 with remainder 11, and will divide 2,708 with remainder 17?

16. Multiply 175 rd. 9 in. by 144.

17. A man owns $\frac{3}{7}$ of a store, and sells $\frac{4}{5}$ of his share for \$492.

18. The ages of five boys are respectively 15 yr. $4\frac{1}{2}$ mo.; 14 yr. 2 mo.; 12 yr. $1\frac{1}{2}$ mo.; 14 yr. 10 mo.; 14 yr. $8\frac{1}{2}$ mo. Find their average age.

1. A company charges \$30.37½ for insuring \$1,350 worth of property. What was the rate of insurance?

2. A mill was insured for \$5,000 in one company at 1¼% and for \$6,000 in another company at 1½%. What was the total premium paid?

3. A bankrupt pays 42½¢ on a dollar. How much will a creditor lose whose bill is \$1,460?

4. A bankrupt's liabilities are \$30,000 and his assets \$8,000. How much can he pay on a dollar?

5. A house is insured for ¾ of its value at 1½%. The premium is \$81.00. What is the value of the house?

6. A merchant fails in business, owing \$7,200. His assets are \$3,000. How much will a man receive who is creditor to the amount of \$600?

7. My horse and buggy together are worth \$300, and the horse is worth 4 times as much as the buggy. What is each worth?

8. If the divisor were one-third what it is, the quotient would be 948. What is the quotient?

9. If 63 be added to a certain number it will contain forty-two 246 times. What is the number?

10. How many times must 720 be added to 522 to make 987,642?

11. A man bought an equal number of lemons and oranges for \$6.25. For the lemons he paid 2¢ each, and for the oranges 3¢ each. How many of each did he buy?

12. One train left Boston at 1 P.M. on the B. & A. R. R. A second train left at 3 P.M. The first goes 30 miles an hour, and the second 40 miles an hour. When will the second overtake the first? and how many miles from Boston?

13. What fraction divided by ⅔ of 12 will give ⅘ for a quotient?

14. If .3 of a farm is worth \$963, what is the value of ⅔ of the farm?

1. Make out a correct bill, supplying dates and items.

2. Make out a correct monthly statement.

3. A dealer bought 13 head of young cattle for $325. He kept them for 4 months at an expense of $2 a head a month, and then sold them at $32 each. Did he gain or lose? and how much?

4. It is 40 rd. round a field. At $22.65 a thousand find the cost of rails for the fence. Each rail is 11 ft. long, and the fence 6 rails high.

5. A farmer raised 8,526 bu. of wheat. He had it ground into flour. If 1 bu. made 40 lb. of flour, how many barrels did he receive?

6. A horse and carriage are valued at $420; $\frac{1}{3}$ of the value of the horse is equal to $\frac{1}{4}$ of the value of the carriage. Find the value of each.

7. A bought pears at the rate of 6 for 5 cents, and B bought peaches at the rate of 3 for 4 cents. How many peaches should B give to A for 120 pears?

8. If telegraph poles cost 25¢ each, and wire $\frac{3}{4}$ of a cent a yard, how much will the material cost for 2 miles of telegraph line consisting of 6 wires, if the poles are 80 ft. apart?

9. A rectangular field containing 27 A. is 40 rd. wide. What will it cost to fence it at 35¢ a yard?

10. A wagon upon which 4-ft. wood was piled was 12 ft. long. How high was the wood, if there were $2\frac{1}{2}$ cd.?

11. Find the number of board feet in 14 planks, $8\frac{1}{2}$ ft. long, 16 in. wide, and $3\frac{1}{2}$ in. thick.

12. What will it cost to plaster a room 32 ft. long, 18 ft. wide, and 13 ft. high, at 15¢ a square yard, allowing 148 sq. ft. for openings.

13. At what rate will $652 gain $440.10 in 15 years?

14. What sum of money on interest at $4\frac{1}{2}\%$ will yield an annual interest of $1,200?

MEASUREMENTS.

1. What is the cost of digging a cistern in the form of a cylinder whose diameter is 6 ft., and whose depth is 18 ft., at 62¢ a cubic yard? How many gallons of water will it hold?

2. A grocer placed in his window a pyramid of oranges 5 ft. high, and 6 ft. square at the base. How many dozen oranges did he use, if 9 oranges fill the space of a cubic foot?

3. A grain-box has a base 8 ft. long and 6 ft. wide. The height of the box is 11 ft. How many bushels of grain will fill the box?

4. A cylindrical shaped bin has a diameter at the base of 16 ft., and the height of the cylinder is 24 ft. This cylinder has a cone-like base, with a depth of 9 ft. How many bushels of grain will the bin hold?

5. A lot was bounded as follows: beginning at the northwest corner, the line ran east 35 ft. to B; thence south 90 ft. to C; thence west 60 ft. to D; thence to A. How many loads of gravel will it take to raise this lot 4 ft.?

6. The following represents a cellar 6 ft. deep. Scale, 1 in. to 10 ft. Draw, starting from the northeast corner, A, south 1 in., west 1 in., south 1 in., east 1 in., south $\frac{3}{4}$ in., east $\frac{1}{2}$ in., south $\frac{1}{16}$ in., west $1\frac{8}{16}$ in., north $\frac{1}{16}$ in., west 2 in., north $2\frac{1}{16}$ in., east 3 in. Find the cost of excavating this cellar at 45¢ a cubic yard.

7. Scale, 1 in. to 8 rd. Find the cost, at $75 an acre, of a field whose boundary runs as follows: beginning at A, the northwest corner, running eastward 26 rd. to B; thence to the southeast to a point C, 12 rd. east of D, a point 24 rd. directly south of B; thence southwesterly to E, 24 rd. south of D; thence west 26 rd. to F; thence northwest to G, which is 12 rd. west of H, a point 24 rd. north of F; thence to A.

8. How many board feet in 100 boards, each 8 in. wide and 12 ft. long?

ORAL.

1. Find 20% of 50 men. 70% of 120 yr. 25% of 120 bu. $62\frac{1}{2}\%$ of 64 days.

2. Find 50% of 600 yd. $8\frac{1}{3}\%$ of 72 bu. 40% of 80 tons. 5% of \$40.

3. A farmer raised 4,200 bu. of grain, and sold 20% of it. How much did he sell?

4. A house was bought for \$4,400, and sold at a gain of 25%. Find the selling-price.

5. 40 is 25% of what number? 60 is 10% of what number? 80 is 40%? 12 is $16\frac{2}{3}\%$?

6. 64 is 20% of what number? 125 is 50%? 70 is $33\frac{1}{3}\%$? 30 is $12\frac{1}{2}\%$? 200 is $66\frac{2}{3}\%$?

7. A farmer owns 420 acres of land, which is 25% of what his neighbor owns.

8. What per cent of 75 is 15? Of 80 is 40? Of 80 is 32? Of 120 is 30? Of 72 is 27?

9. What per cent of 120 is 90? Of 400 is 160? Of 200 is 120? Of 64 is 40? Of 90 is 30?

10. What per cent of 63 is 27? Of 56 is 49? Of 48 is 6? Of 90 is 15? Of 160 is 10?

11. If you buy an article for \$210, and sell it for \$42 gain, what per cent do you gain?

12. A regiment entered battle with 960 men, and came out with 912 men; what per cent were missing?

13. A merchant buys lead-pencils at $\frac{1}{2}¢$ each, and sells them at 3¢ each; what per cent does he gain?

14. If a merchant buys goods for $\frac{6}{7}$ of his selling-price, what per cent does he gain?

15. A man is 72 years old, and $12\frac{1}{2}\%$ of his age is 25% of his son's age. What is the son's age?

16. My house is insured for \$4,000 at $1\frac{3}{4}\%$ premium. Find the premium.

1. In a certain school $\frac{1}{10}$ of the pupils are under 8; $\frac{1}{8}$ between 8 and 12; $\frac{1}{4}$ between 12 and 14; $\frac{3}{16}$ between 14 and 16; and 27 are over 16. What is the whole number of pupils?

2. Bought a house and lot for \$8,000. For what must I rent a month to gain 6% on my money, and pay \$36 for repairs, \$24 for insurance, and taxes at $1\frac{1}{2}$% on $\frac{3}{4}$ of its cost?

3. Three-sevenths of a certain number exceeds $\frac{1}{4}$ of the same number by 25. What is the number?

4. What will it cost to insure a house worth \$4,000 at $\frac{1}{2}$% on $\frac{3}{4}$ of its valuation and \$2,400 worth of furniture at $\frac{3}{5}$% on $\frac{4}{5}$ of its value?

5. Sold cloth at \$1.19 a yard, and lost 15%. For what should it have been sold to gain 15%?

6. What number is that which, multiplied by three thousandths, will give 3,645?

7. What is the amount of \$1,950 for 2 yr. 1 mo. 3 da. at $4\frac{1}{2}$%?

8. In what time will \$127.30 gain \$31.825 interest at 6%?

9. The premium at 3% is \$756; what is the value of the property insured?

10. My agent sold for me some property for \$1,080, and charged me \$81 commission. What per cent did he charge?

11. If 6 cows eat 13 tons of hay in a winter, how much will 14 cows eat?

12. If 24 lb. of butter can be made from 360 qt. of milk, how much milk will be required to produce 100 lb. of butter?

13. Reduce $\frac{2}{15}$ bu. to quarts.

14. If $\frac{4}{5}$ of A's money is increased by $\frac{1}{3}$ of $\frac{1}{2}$ of his money, the sum will equal \$198. How much money has he?

15. A boy's money diminished by $\frac{1}{4}$ and $\frac{1}{5}$ of itself, equals \$1.32. How much has he?

16. If $5\frac{1}{2}$ bu. of wheat cost \$9.90, how much will $\$121\frac{1}{2}$ buy?

17. Reduce 16,568 cu. ft. to cords.

1. If a man can build $\frac{4}{7}$ of a wall in $5\frac{1}{3}$ days, how long will it take him to finish it?

2. A dealer bought 200 bu. of potatoes at 45¢ a bushel. If he lost 30% of them, at what price a bushel must he sell the remainder to gain 20% on his investment?

3. At 55¢ a cubic yard, what will it cost to dig a well 5 ft. in diameter and 30 ft. deep?

4. A church spire is an hexagonal pyramid. Each side is 6 ft. at the base, and its slant height is 80 ft. Find the cost of slating it at $6 a square.

5. A dealer buys a chair, the list-price of which is $3.50, at a discount of 20% and 5%, and sells it at 14% above the list-price. What per cent profit does he make?

6. Divide 40 cents among 3 boys, A, B, and C, in such a way that B and C may each have twice as much as A. How many cents will each have?

7. A farmer has a trapezoidal lot whose parallel sides are 35 rd. and 84 rd., and the perpendicular distance between the parallel sides is 32 rd. At $3.25 an acre, what will it cost to plow the field?

8. If 16 men can do a piece of work in 12 days, how many men will be needed to do 3 times as much work in $\frac{1}{3}$ of the time?

9. A dealer in second-hand furniture sold two organs at $45 each. On one he gained 20%, and on the other he lost $17.50. For what should he have sold the two to gain 15%?

10. A farmer raises $4\frac{1}{2}$ tons of hay on $2\frac{3}{4}$ acres of land. How many tons can he raise on $12\frac{3}{8}$ acres?

11. If 20 men earn $1,280 in 8 days, how much will 36 men earn in 30 days?

12. Find the entire area in the walls and ceiling of a room 16 ft. 4 in. long, 13 ft. 8 in. wide, and 11 ft. 4 in. high.

13. How many board feet in a board 15 ft. long, 18 in. wide at one end, and 14 in. wide at the other end, and $\frac{1}{2}$ in. thick?

1. A man sold two houses for $3,600 each. On one he gained 25%, and on the other he lost 25%. Did he gain or lose on the entire transaction? and how much?

2. Find the surface of a sphere 12 in. in diameter.

3. An agent's commission at 3% is $330. What sum did he remit to his employer?

4. An agent sold goods on a commission of 2½%. If he remitted $487.50 to his employer, what was the amount of goods sold?

5. If oats are 36¢ a bushel, find the cost of oats that will fill ¾ of a bin 8 ft. 6 in. long, 5 ft. 4 in. wide, and 6 ft. 8 in. high.

6. What will 25 bu. 3 pk. 2 qt. of cherries cost at 8¢ a quart?

7. Reduce to simple fractions: .6 of $4\frac{2}{3}$. $\frac{.8}{\frac{2}{3} \text{ of } 6}$.

8. Find the volume of a cone whose altitude is 12 ft., and the radius of the base 4 ft.

9. A man has a circular fish-pond 30 yd. in diameter. He makes a circular gravel-walk round it 6 ft. wide. Find the area of the walk.

10. At what rate will $905.00 gain $97.74 interest in 2 yr. 4 mo. 24 da.?

11. Find the interest of $1,235.62 for 4 yr. 5 mo. 17 da. at $6\frac{2}{3}$%.

12. How many square yards of zinc will be required to line a cylinder 8 ft. in diameter and 40 ft. high, including both ends?

13. What will 30 scantling cost, each 16 ft. long, 3 in. wide, and 4 in. thick, at $32 per thousand, board measure.

14. At $6½ a cord, find the cost of wood that can be piled in a shed 120 ft. long, 60 ft. wide, and 15 ft. high.

15. At $1.20 a yard, what will be the cost of carpet 27 in. wide laid lengthwise on the floor of a room 24 ft. 6 in. by 18 ft.

1. Reduce $\frac{1}{2}\frac{3}{5}$ to a fraction whose denominator is 500.

2. Find the value of a mill if $\frac{5}{6}$ of $\frac{3}{8}$ of it is worth $4,690.

3. A man owned $\frac{3}{4}$ of a large factory. He sold $\frac{6}{7}$ of his share for $9,900.90. What is the value of the factory?

4. $\frac{1}{3}$ of $\frac{5}{6}$ of 378 is $\frac{3}{8}$ of $\frac{7}{12}$ of what number?

5. The product of three numbers is 79. Two of them are $8\frac{1}{5}$ and $6\frac{1}{3}$. What is the other?

6. What is the cost of 3,170 lb. of iron at $9\frac{1}{2}$ a ton, and 10,160 lb. at $6\frac{1}{4}$ a ton?

7. A bought 140 oranges at the rate of 2 for a cent, and 150 at the rate of three for a cent, and sold them all at the rate of 5 for two cents. Did he gain or lose? and how much?

8. A rectangle is 27 ft. wide, and contains 945 square feet. What is its length?

9. If $15\frac{3}{4}$ bbl. of flour cost $63, what will 10.4 bbl. cost?

10. At $7\frac{1}{2}\%$, what is the interest of $864 for 2 yr. 11 mo. 13 days?

11. A and B are together worth $102,375. How much does each own, if A owns $\frac{1}{1}\frac{9}{7}$ as much as B?

12. A man bought $\frac{5}{8}$ of a mill, and sold $\frac{2}{3}$ of what he bought to one man, and the remainder to another man for $4,000. What was the value of the mill?

13. How much did a lawyer receive for collecting his bills, one of $225 at $8\frac{1}{2}\%$, and the other of $789 at $9\frac{1}{3}\%$?

14. A man invested $\frac{1}{3}$ of his money in real estate, $\frac{1}{4}$ in a mill, $\frac{1}{7}$ in bank-stock. The remainder, $2,300, he kept in cash. How much was he worth?

15. A barn is 40 ft. long and 20 ft. wide, with 16-ft. posts, and gables 8 ft. high. Find the cost of painting the barn, if the work costs 80¢ a square, and it takes 20 gal. of paint at $1.50 a gallon.

16. An agent remitted his employer $8,775 for the sale of some land. If his commission was $2\frac{1}{2}\%$, what was the value of the land sold?

1. Sold my watch for $39 at a loss of 22%. For how much should I have sold it to gain 35%?

2. If your father's house, worth $9,000, is insured for $\frac{3}{4}$ of its value at $\frac{1}{8}$% premium, what would be his actual loss if it should burn?

3. At what rate of interest will $240 amount to $269.40 in 3 yr. 6 mo.?

4. Two men bought a bicycle for $86. One paid $26 more than five times as much as the other. What did each pay?

5. A man paid a debt of $36 in 3 different payments. The second payment was $4 more than the first, and the third was twice as much as the second. What was the first payment?

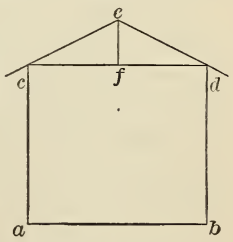
6. If a cubic foot of oak wood weighs 54 lb., and the ratio of the weight of white pine to the weight of white oak is as 17 to 27, what will a cord and a half of white pine weigh?

7. Find the cubic contents of a triangular prism the area of whose base is 35 sq. ft., and whose altitude is 6 ft. 8 in.

8. How many gallons of water will fill a cylindrical boiler 4 ft. 3 in. high, and 12 in. in diameter?

9. A circular fish-pond whose circumference is 314.16 ft. has a walk around it 10 ft. wide. What will it cost to gravel the walk at the rate of 32¢ a square yard?

10. This figure represents the gable end of a house 48 ft. long. $ab = 36$ ft.; $ac = 32$ ft.; $ef = 9$ ft.; $ed = 21$ ft. Find the number of board feet of lumber that will be required to roof, board, and floor the whole house. There are two stories and an attic.



11. What is the area of an isosceles triangle whose base is 20 ft. and altitude 18 ft.?

12. The area of a triangle is 540 sq. ft., and the altitude is 108 ft. What is the base?

1. What is the difference on a bill of $1,275 between a discount of 40% and a discount of 30% and 10%?

2. What per cent is gained by selling articles at 21¢ each that cost $3.36 a dozen less 25% and 14⅔%?

3. If you buy a bicycle at a discount of 25% from the list price, and sell at list-price, what is your gain per cent?

4. A lawyer, collecting a note at a commission of 5%, received $9.75. What was the face of the note?

5. What principal will amount to $3952.00 in 2 yr. 7 mo. 10 da. at 9%?

6. At what rate will $1,926, in 2 yr. 8 mo. 24 da., produce $263.22 interest?

7. William has a certain number of marbles; Charles has five times as many as William; Henry has as many as twice William's subtracted from Charles's; and Henry's added to William's are equal to 40. How many has each?

8. What was the amount of risk if $25.20 was paid for insurance at 70¢ on $100?

9. Find the per cent of loss on a bill of goods bought for $3,360 and sold for $2,520.

10. What number decreased by 25% is $342.60?

11. Find the number of feet, board measure, in a plank 24 ft. long, 9 in. wide, and 3 in. thick.

12. Scale, ⅛ in. to a rod. Draw a plan of Mr. Gordy's farm, whose boundary runs as follows: From A east to B, 30 rd.; from B south to C, 12 rd.; from C east to D, 24 rd.; from D south to E, 36 rd.; from E west to F, 54 rd.; from F north to A. Find the whole area of his farm, and the length of his boundary fence. Connect A and C with E, and find the area of each of the three fields.

13. A man after drawing out 20% of his money, and then 10% of the remainder, found that he had in the bank $1,512. How much had he in the bank at first?

RULES FOR PRACTICAL MEASUREMENTS.

1. In painting and plastering, it is customary to deduct from the whole area of the room one-half of the area of all doors, windows, or openings. This rule is not always observed.

2. PAPERING. American wall-paper is usually $1\frac{1}{2}$ ft. wide and 24 ft. long for a single roll, 48 ft. long for a double roll.

There are various rules: —

(*a*) Find the perimeter of the room in feet, and divide by $1\frac{1}{2}$ ft. (width of paper); the quotient equals the number of strips of paper required. Divide the length of a roll by the height of the room to find the number of strips in a roll. Divide the strips in the room by the strips in a roll to find the rolls required.

In the first and third division, if there is a fraction, take the next higher integer; in the second division, take the next lower integer.

(*b*) Same as *a*, except from perimeter of room, deduct the width of doors and windows.

Use this method unless otherwise directed.

(*c*) Find the area as for plastering, divide the square feet in the area by 36 (the square feet in one roll of paper); this will give the number of rolls.

3. SHINGLING. Shingles are packed in bunches. 4 bunches make 1000. They are sold by the bunch.

A thousand will cover 100 sq. ft. when laid 4 in. to the weather; 6 in. to the weather, it will take 600 shingles; 7 in. to weather, 515 shingles; 8 in., 450 shingles; 9 in., 400 shingles.

Find the number of squares, then compute the number of shingles.

4. LATHS. A lath is 4 ft. long, and $1\frac{1}{2}$ in. wide, usually nailed $\frac{3}{8}$ of an inch apart. There are 50 laths in a bunch. A bunch will cover 3 square yards.

Find the number of square yds. and divide by 3 to find the number of bunches of laths required.

5. CLAPBOARDS. A clapboard is usually 4 ft. long, 6 in. wide, and 25 are put in a bundle. They are usually laid $3\frac{1}{2}$ in. to the weather. 1 bunch will cover 25 sq. ft. after making allowance for waste.

Find square feet in area, and divide by 25 to find the number of bunches required.

NOTE. — Laths and clapboards are sold only by the bunch. One-half of openings is usually deducted in making estimates.

RULES FOR PRACTICAL MEASUREMENTS — CONTINUED.

1. Stone Masonry. All stone work is reckoned by the cubic foot or by the perch (24 cu. ft.) or cord (120 cu. ft.).

In measuring for cellars and buildings the distance round the outside of the walls is taken for the length, thus measuring each corner twice. This is considered an offset for the greater labor in constructing the corners. For the same reason no allowance is made for an opening unless it is a large one; then deduct one-half.

2. Brick Work. In measuring, the same rule applies as in stone work.

(*a*) Find the number of square feet in the surface, and multiply by 7 if the wall is one brick in thickness; by 14 if 2 bricks in thickness; by 21 if 3 bricks in thickness.

(*b*) Find the number of cubic feet in the wall, and multiply by 22; for 22 bricks including mortar fill 1 cubic foot.

3. To find capacity of bins. A bushel contains 2150.4 cu. in. This is nearly $1\frac{1}{4}$ times a cubic foot.

(*a*) For practical purposes take $\frac{4}{5}$ of the number of cubic feet in the bin for the required number of bushels.

(*b*) For accurate purposes divide the number of cubic inches by 2150.4.

Note. — Use the first method unless the second is asked for.

Note. — In measuring bulky fruits and vegetables, as apples and potatoes, a bushel will fill $1\frac{1}{2}$ cu. ft. Then find $\frac{2}{3}$ of the number of cubic feet for the number of bushels. In small fruit, as berries, or in grain, $1\frac{1}{4}$ cu. ft. are used.

4. To find the number of gallons in a cistern. A gallon contains 231 cu. in. Hence $7\frac{1}{2}$ gal. equals 1 cu. ft., and 1 bbl. equals $4\frac{1}{5}$ cu. ft. 1 gal. of water weighs $8\frac{1}{3}$ lb. 1 cu. ft. of water weighs $62\frac{1}{2}$ lb.

(*a*) Multiply the cubic feet in the cistern by $7\frac{1}{2}$, to find number of gallons.

(*b*) Divide the cubic inches in cistern by 231, to find the number of gallons.

5. To measure coal. A short ton of hard or anthracite coal measures about 36 cu. ft. A short ton of soft or bituminous coal measures about 42 cu. ft.

Divide the cubic feet in the bin by 36 or 42 as the case demands.

6. To gauge or find the volume of a barrel or cask. Find mean diameter. This is the head diameter plus two-thirds of the difference between the head and bung diameters.

(*a*) Square the mean diameter (multiply it by itself); multiply by the length of the cask in inches and that by .0034; the result will be the number of gallons.

(*b*) When the cask is not full, multiply the square of $\frac{1}{3}$ of the sum of the head, mean, and bung diameters in inches by the depth of the liquid in inches, and this by .0034.

APPLICATIONS OF THE PRACTICAL RULES OF LESSONS 47 AND 48.

1. At $4.25 per M. how much will the shingles cost for a double roof, rafters 22 ft. long, house 34 ft. long? The shingles are laid 4 in. to the weather.

2. At $2.75 per M. how much will the lath cost for a ceiling 18 ft. by 24 ft.?

3. How many barrels of water will a cistern hold that is 6 ft. by 7 ft. by 8 ft.

4. A cistern 6 ft. wide and 10 ft. long, holds 40 bbl. of water. How deep is the water?

5. How many barrels of water in a cistern 6 ft. in diameter, if the water is 6 ft. deep?

6. How many barrels of apples will a crib contain that is 8 ft. wide, 9 ft. high, and 30 ft. long?

7. A bin 6 ft. wide and 10 ft. long, holds 150 bu. of potatoes. How high is the bin?

8. A house is to be built 40 ft. by 30 ft. If the wall beneath it is to be 6 ft. high and 16 in. thick, how many cords of stone are required?

9. How many bricks are required for the 8-in. walls and bottom of a rectangular cistern, the outside dimensions of which are: length 8 ft., depth 7 ft., width 6 ft.?

10. A room is $16\frac{1}{3}$ ft. by 15 ft. Carpet is $\frac{3}{4}$ yd. wide. If the breadths run widthwise of the room, and there is a waste of 6 in. on each breadth for matching, how many yards of carpet will it take?

11. If in the room above the figure on the carpet is $2\frac{1}{2}$ ft. in length, which way should the breadths run to have the least waste in matching?

12. If the carpet was a yard wide, which way should the breadths run to have the least to turn under?

13. Do the answers to 11 and 12 agree?

APPLICATIONS OF LESSONS 47 AND 48 — CONTINUED.

1. How many gallons in a cask whose head diameter is 24 in., bung diameter 30 in., and length 35 in.?

2. What is the volume of a cask whose length is 40 in., and the diameters respectively 21 and 30 in.?

3. How many board feet in a stick of timber 36 ft. long, 9 in. thick, 12 in. wide at one end and 8 in. wide at the other?

4. A bin is 6 ft. wide and $4\frac{1}{2}$ ft. deep. It contains 324 bu. of potatoes. How long is it?

5. If 1 bu. of wheat will make 48 lb. of flour, how many barrels of flour can be made from the wheat in a bin 12 ft. long, 6 ft. wide, and 4 ft. deep, if 4 lb. are wasted in putting it in barrels?

6. During a storm a cellar 40 ft. long, 20 ft. wide, and 8 ft. deep was filled $\frac{3}{5}$ full of water. At 2¢ a barrel, what will it cost to pump out the water?

7. At $1.75 a rod how much less will it cost to fence a field 80 rd. square, than a field of the same area twice as long and one-half as wide?

8. A room $18\frac{1}{3}$ ft. long and 15 ft. wide is carpeted with Brussels carpeting worth $1.12\frac{1}{2}$ a yard. Find the cost of carpeting the room if the breadths run lengthwise, with an allowance of 8 in. on each breadth for matching.

9. A circular cistern is 5 ft. in diameter. If the water in it is 8 ft. deep, how many gallons are there?

10. At $4.00 per M. find the cost of shingles for a roof 50 ft. long, and each of the two sides $23\frac{1}{2}$ ft. wide, if you allow 1000 shingles for every 125 sq. ft.

11. A brick house is 32 ft. long, 28 ft. wide, 24 ft. high. The roof has a half pitch, and the walls are 16 in. thick. There are 24 windows 2 ft. 10 in. by 6 ft. 2 in., and 5 doors 3 ft. 4 in. by 8 ft. 6 in. How much will the bricks cost at $4.25 per M.?

APPLICATIONS OF LESSONS 47 AND 48 — CONTINUED.

1. How many tons of soft coal can be put in a bin 8 ft. by 6 ft. by 4 ft.?

2. How far must a man walk in plowing lengthwise a field 15 rd. long, 8 rd. 12 ft. wide, if each furrow is 18 in. wide?

3. A roof is 36 ft. long, and each side 24 ft. wide. Slates are 16 in. by 12 in., and lap one-half. How many slates will it take?

4. At 25¢ a cut, find the cost of sawing into 4 pieces a pile of wood 56 ft. long, 4 ft. high, and 4 ft. wide.

5. At 18¢ a pound, $4\frac{1}{2}$ lb. to a square foot, find the cost of lead to line a tank 6 ft. by 5 ft., and $4\frac{1}{2}$ ft. deep.

6. A house is 38 ft. long, 24 ft. wide, and 20 ft. high, with a gable 8 ft. high. How many bundles of clapboards will it take to cover the house?

7. A hall is 18 ft. by $6\frac{1}{2}$ ft., and $7\frac{1}{2}$ ft. high. There is 1 door and 1 window, each $3\frac{1}{2}$ ft. wide. At 24¢ a roll, find the cost of the paper.

8. At \$4.12$\frac{1}{2}$ a cord, find the cost of a pile of wood 8 ft. long, 4 ft. wide, and 3 ft. high.

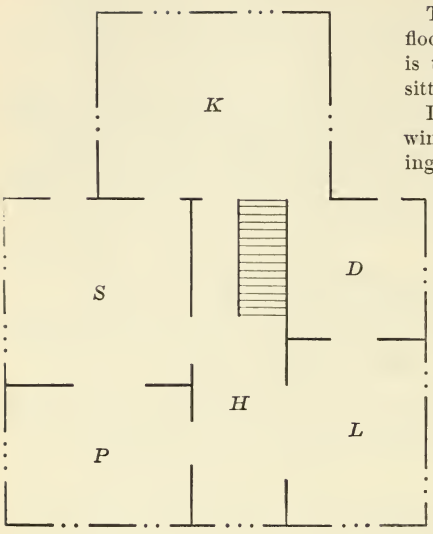
9. A's lot is 400 ft. by 25 ft., and B's is 100 ft. square. Which has the larger area? Which man will pay the more for fencing, and how much more at 32¢ a foot?

10. A building-lot containing $\frac{1}{5}$ of an acre is 36 ft. wide. How deep is it?

11. What length must be cut off an inch board 8 in. wide to obtain 3 board feet?

12. If a man can walk 1 mile 15 rd. in 20 min., how many hours will it take him to walk 34 mi. 175 rd.?

13. The walls of a hall are 120 ft. long, 75 ft. wide, 30 ft. high, and 21 in. thick. At \$3 per M. find the cost of brick, deducting one-half for openings; 12 windows, 3 ft. by 6 ft.; 4 doors, 5 ft. by 10 ft.



This plan represents the ground floor of a house. *L* is the library; *D* is the dining-room; *P*, parlor; *S*, sitting-room; *K*, kitchen; *H*, hall.

Dimensions of rooms, doors, and windows must be found by measuring. Each room is 9 ft. high. The height of the double doors is 8 ft.; of the single doors, 7½ ft., and of the windows, 6 ft. The hall, and all rooms except the kitchen, have a 10-in. baseboard. The kitchen is sheathed 3 ft., but under windows 1½ ft. high. Scale, ¼ in. to 4 ft.

1. At 18¢ a square yard, find the cost of painting the floor and sheathing in the kitchen.

2. At 9¢ a square yard, find the cost of kalsomining the ceiling and walls in the kitchen.

3. At 35¢ a square yard for plastering, find the cost of the walls and ceiling of the dining-room.

4. An 18-in. border of hard wood is laid all around the dining-room. Find the cost at $2.50 a square foot.

5. The rest of the dining-room floor is covered with linoleum. What will it cost at 60¢ a square yard?

6. The hall is inlaid at a cost of $1.25 a square foot. Find the cost.

7. Without reference to the staircase, find the cost of papering the hall at 75¢ a roll.

8. Find the cost of Brussels carpet laid lengthwise for the parlor. No allowance for matching. Cost, $1.75 a yard.

9. Find the number of rolls of paper for the walls of parlor.

10. Paint the ceiling of the parlor at 35¢ a square yard.

NOTE.—The first 10 examples in this lesson refer to the diagram in Lesson 52.

1. Find the cost of papering the walls and ceiling of the sitting-room with paper costing 37½¢ a roll.

2. A rug 8 ft. by 10 ft. covers the center of the floor of the sitting-room. Find the area of floor uncovered.

3. At 2¢ a foot, find the cost of molding for all the rooms except the kitchen and hall.

4. There are 12 steps, each 8 in. wide, and 9 in. high. Find the yards of carpet needed for the stairs if there is a waste of 1½ in. on each step for turning corners.

5. There is a cellar under the whole house 5 ft. deep. Find the cost of excavating it at 30¢ a load.

6. The cellar stone wall is 5 ft. high, and 18 in. thick. Find its cost at 35¢ a perch.

7. Above the stone wall is a brick wall 2 ft. high, 16 in. thick. Find the cost of bricks at $3.50 per M.

8. The roof has a one-fourth pitch, and the rafters are 18 ft. long on the main part of the house, and 16 ft. on the ell; posts 17 ft. Find the bunches of clapboards needed.

9. Find the number of shingles laid 4 in. to the weather.

10. A piazza is built across the front and on two sides of the main house. In front it is 10 ft. wide, on the sides 8 ft. wide. Find the board feet of lumber needed for the floor of the piazza.

11. Suppose that W. R. Jones borrows of you $175 for one year with interest, write the negotiable promissory note that Mr. Jones should give you.

12. What sum must be invested at 7% to give a semi-annual income of $437.50?

13. Find the sum of money that will amount to $1,494.80 in 4 yr. 1 mo. 4 da., at 6%.

14. Find the amount of $5,000 from April 1, 1896, to Nov. 25, 1899, at 5%.

15. Find the interest of $285.74 for 4 yr. 3 mo. at 4%.

APPLICATIONS OF PERCENTAGE.

1. A man sold some property at a profit of 20%, and with the proceeds bought some more property, which he sold for $4,860, at a loss of 55%.

2. A man sold his house and lot for $8,304, at a profit of 15⅓%. If the lot cost ⅔ as much as the house, find the cost of each.

3. Find an agent's per cent of commission, when he received $340.20 on a sale, the net proceeds of which are $9,379.80.

4. I received $1,642.60 for some property which my agent sold for $1,720.

5. As agent, working on 4½% commission, I received $129.51.

6. Find the cost of flour a barrel, when a commission merchant receives $323.00 for selling 1,360 bbl. at 5%.

7. I sold goods on 2% commission, and remitted to my employer $4,777.50.

8. A man bought 2 houses for $3,450, paying 30% more for one than he did for the other. Find the cost of each.

9. Find a man's income when 45% of $1,800 is 18% of ½ of his income.

10. A man having $9,600 in the bank, drew out 14% of it at one time, and then deposited a sum equal to 150% of what he had drawn out. How much had he in the bank then?

11. 66⅔ of the cost of my horse is 65% of the cost of my carriage. If the horse cost $156, find the cost of both.

12. A boy sold two balls for 35 cents. This is a loss of 12½%. Find the cost of a ball.

13. I bought a barrel of flour for $5.94. The dealer gained 44 cents.

14. I sold a house for $638 less than I paid for it. I sold it for 92¾% of its cost.

FRACTIONS.

1. A man lost $\frac{2}{5}$ of his money in business one year, and gained the next year $\frac{5}{9}$ of what he had left. How much had he at first, if at the end of the second year he had $70,000?

2. How many marbles has a boy if the difference between $\frac{5}{7}$ and $\frac{1}{2}$ of the number he has is 135?

3. How many $2\frac{1}{2}$-in. cubes can be cut from a large cube $2\frac{1}{2}$ ft. on a side?

4. One man can do a piece of work in $7\frac{1}{2}$ days; his brother can do it in 6 days. In how many days can both do it working together?

5. What part of 10 A. 140 sq. rd. is 7 A. 80 sq. rd.?

6. Change .0033$\frac{1}{3}$, .0875, and .066$\frac{2}{3}$ to common fractions.

7. A can do a piece of work in 12 days, A and C in 9 days, and A and B in 6 days. In how many days can A, B, and C do it? How many days will it take B and C?

8. A man owned $\frac{5}{8}$ of an acre. How much has he left after selling $28\frac{3}{4}$ square rods?

9. A man had $4,200 of a fortune left after having put $\frac{1}{2}$ of it in a bank, and spending $\frac{1}{4}$ and $\frac{1}{5}$ of it.

10. If $\frac{3}{8}$ of a yard of silk cost $1.20, how many yards will cost $51.60?

11. $\frac{1}{4}\frac{4}{8}$ is what part of $\frac{7}{16}$?

12. What is the cost of $64\frac{1}{2}$ bushels of seed at $2\frac{1}{3}$ a bushel?

13. A man had $13\frac{3}{7}$ acres of land, which he divided into building-lots each containing $\frac{6}{14}$ acres. How many lots did he have?

14. Change .968$\frac{3}{4}$ to a common fraction.

15. Change $\frac{1}{2}\frac{2}{5}$ to 225ths; $\frac{7}{11}\frac{1}{19}$ to 1,309ths.

16. If $8\frac{1}{4}$ tons of coal cost $37$$\frac{1}{8}$, what will $27\frac{4}{5}$ tons cost?

17. George lost $\frac{2}{5}$ of his marbles, then bought $\frac{1}{3}$ as many as he had at first. If he then had 84, how many had he at first?

1. The premium on an insurance of $7,440 is $44.64. What is the rate?

2. If by selling an organ for $30, I lose 25%, at what price should I have sold it to gain $15?

3. Mr. Williams sold a piano to Mr. George at a gain of $14\frac{2}{7}\%$. Mr. George sold it to Mr. Bruce for $320, thus losing 20%. What did Mr. Williams pay for the piano?

4. A teacher's salary after being increased 20% was $3,000.

5. A man received $24 as 20% of the price of a bicycle, sold at a gain of 20%. What did the wheel cost in the first place?

6. Sold $\frac{4}{5}$ of an article for what $\frac{1}{2}$ of it cost. Find the loss per cent.

7. A park 9 rd. square has a walk round it 9 ft. wide. Find the area of the walk round the outside of it.

8. A farmer sold a horse for $72, which was $12 more than $66\frac{2}{3}\%$ of its cost. What per cent did he lose?

9. George spent $15.60, which was 40% of what he had left. How much had he at first?

10. A bin 24 ft. long, 6 ft. wide, and 2 ft. deep is $62\frac{1}{2}\%$ full of oats. How many bushels are in the bin?

11. If you buy $4\frac{5}{6}$ bu. of nuts at 60¢ a peck, and retail them at 10¢ a quart, what will be your per cent of profit?

12. Find the amount of $1,260 for 1 yr. 1 mo. 1 da. at $5\frac{1}{2}\%$.

13. On a bill of $600 a dealer offered me a discount of $33\frac{1}{3}\%$ or 25% and 10%. I chose the latter, how much did I lose or gain?

14. A second-hand organ was sold for $72 at a gain of $12\frac{1}{2}\%$. What per cent would have been gained or lost had it sold for $56?

15. A bill of goods amounted to $5,650. It was offered for sale with 20% and 5% discount and 10% off for cash. The offer was accepted. For how much were the goods sold?

1. The surface of a lake is $4\frac{1}{2}$ sq. mi. How many gallons of water will it take to raise the surface $\frac{1}{2}$ in.?

2. How many cubes whose sides are 4 in. are equal in volume to a cube whose side is $2\frac{1}{2}$ ft.?

3. If George has $33\frac{1}{3}\%$ more marbles than his brother, what per cent less than George has his brother?

4. A man sold a bicycle for \$93.10, thereby losing 5%.

5. A man sold $\frac{3}{8}$ of a barrel of flour for what $\frac{5}{8}$ cost, and the rest of the barrel for what $\frac{1}{2}$ cost. What was the gain or loss per cent on the whole barrel?

6. How many blocks $7\frac{1}{2}$ in. by $4\frac{1}{4}$ in. will it require to pave a lot 100 ft. by $12\frac{3}{4}$ ft.?

7. If $\frac{5}{11}$ of an acre of land cost \$37.75, what will $43\frac{1}{5}$ acres cost?

8. What is the expense for carpeting a room 17 ft. 6 in. long, 14 ft. wide, with carpet $\frac{7}{8}$ yd. wide at \$1.25 a yard; breadths to run lengthwise?

9. The ratio is $3\frac{1}{4}$ and the consequent 12. What is the antecedent.

10. A room is 20 ft. square and 10 ft. high. If each side of the room were 10 ft. longer, how much greater would the entire surface of the room be?

11. A merchant marked his goods at 75% above cost, and sold them at $33\frac{1}{3}\%$ below his marked price, deducting 10% for cash. What per cent of profit did he make?

12. Divide two thousandths by eight millionths.

13. In what time will \$590 gain \$76.70 at 4%?

14. The wages of 20 men for 12 weeks are \$870; what will 8 men earn in $3\frac{1}{2}$ weeks at the same rate?

15. At $16\cent$ a square foot, what will it cost to paint the ceiling of a room 15 ft. 6 in. long, and 12 ft. 6 in. wide?

16. What is the acreage of a rectangular field whose length is 234 rd. and whose breadth is 165 rd.?

1. By selling goods for $47.50 a man lost 5%. What would he have gained if he had sold them for $57?

2. If you buy oranges at 30¢ a doz., and sell them at $2.80 a hundred, what will be your gain per cent?

3. At 18½¢ a roll, how much will it cost to paper a room 20 ft. long, 17 ft. wide, and 12 ft. high? There are 2 doors, each 7 ft. by 4½ ft.; 2 windows, each 6 ft. by 4½ ft.; a fireplace, 6 ft. by 6 ft., and a base-board 1 ft. high.

4. A can do a piece of work in 12 da., and B can do it in 15 days. They work together for 5 days, when C joins them, and the work is finished by the three in one day. How long would it take C to do the work alone? How long A and C? B and C? A, B, and C?

5. A man bought 20 sheep for $250, and 20 cows for $1,050. He sold the sheep at a gain of 12½%, and the oxen at a gain of 7½%. Find his total gain.

6. A man leaves by will $4,500 to his wife, and the remainder of his property to be equally divided among his three children. It was found that the share of each child was one-fifth of the whole property. How much did the man leave?

7. In the center of a room 23½ ft. square, there is a rug 18 ft. square. The rest of the floor is covered with oil-cloth which extends under the rug 6 in. Find the total cost, if the rug cost $1.75, and the oil-cloth 85¢ a square yard?

8. At what rate per cent will $7,600 gain $76 in 3 months?

9. A walk is 180 ft. long and 4 ft. wide. How much will the walk be raised if 10 loads of ashes are spread uniformly over it?

10. Find the interest on $678.27 for 2 yr. 7 mo. at 4%.

11. If 7 men build 6⅔ rd. of wall in 15½ days, in how many days can 12 men do as much?

12. If by selling land at $80 an acre I lose 25%, how must I sell it to gain 40%?

1. If the sod $2\frac{1}{2}$ in. thick is removed from a field containing $\frac{1}{2}$ of an acre, how many cubic yards are taken?

2. A garden whose breadth is 4 rd., and length $2\frac{1}{2}$ times its breadth, has a wall 2 ft. thick and 3 ft. high around it, outside of the line. Find the cost of the wall at 5¢ a cubic foot (exact measurement).

3. Outside of the wall in example 2 is a ditch 3 ft. wide and 4 ft. deep. What did it cost to dig it at $1\frac{1}{2}$¢ a cubic foot?

4. How many bricks will be required to build a house 36 ft. long, 28 ft. wide, and 20 ft. high? The wall is $1\frac{1}{3}$ ft. thick, and has four doors 4 ft. by 8 ft., 32 windows, 3 ft. by 6 ft.

5. If it takes 3 days to dig a cellar that measures 8 ft. each way, how long will it take to dig one of the same depth, but the other dimensions $1\frac{1}{2}$ times as large?

6. What is the area of a circular pond which contains 15 times as much area as one 25 rd. in diameter?

7. What is the value of a lot of land $4\frac{1}{2}$ rd. long, 50 ft. wide in front, 42 ft. wide in the rear, at 65¢ a square foot?

8. How many board feet in 15 sticks of timber 27 ft. 9 in. long, and the other dimensions 8 in. and 10 in.?

9. A built a square house 40 ft. on each side. B built a house containing the same area, but 80 ft. long. The perimeter of A's house is what per cent of the perimeter of B's house?

10. A general placed 4800 men in three regiments so that the 2d regiment had twice as many as the 1st regiment, and the 3d regiment had as many as both the others. How many were placed in each regiment?

11. Three times, eight times, and four times a number is 360. What is the number?

12. In what time will \$165 amount to \$179.85 at 6%?

13. If 15% is lost by selling an estate for \$10,200, for what must it be sold to gain 20%?

14. Reduce 563,147 inches to feet, etc.

ORAL.

1. How many cubic feet in a rectangular block 2 ft. square at the end and 6 ft. long?

2. How many times larger would a block be that was twice as long, twice as wide, and twice as thick?

3. How many blocks $\frac{1}{4}$ of an inch on a side can be sawed from a 2-in. cube?

4. When a number is used twice as a factor, or multiplied by itself, the product is called the square of a number.

5. Name the squares of the numbers from 1 to 10.

6. When the number is used three times as a factor, the product is called the cube of the number.

7. Name the cubes of the numbers from 1 to 10.

8. When 100 shares of bank-stock are sold for $17,650, what is the price per share?

9. Divide 24,584 by 10; by 100; by 1,000.

10. Divide 16,485 by 10,000; by 1,000; by 100; by 10.

11. At $7.50 each how much will 100 trunks cost?

12. At $2.50 each, how many chairs can be bought for $50?

13. Separate $20 into 5 equal piles. What is the answer? Since you are asked to find $\frac{1}{5}$ part of $20, examples like this are called Partitive Division.

14. Separate $20 in piles of $4 each. What is the answer? Since here the size of the pile is given, and we are asked to measure the larger pile by it to find the number of piles, this is called Measuring Division.

15. Name the terms used in Division.

16. In the partitive form of division, which of these terms are alike?

17. In the measuring form of division which of the terms are alike?

18. Make an example to illustrate Partitive Division.

19. Make an example to illustrate Measuring Division.

1. I insured my buildings for $\frac{3}{4}$ of their value at $\frac{3}{5}\%$. The premium was \$24. What was the value of the buildings?

2. What is the retail price of a dictionary if it cost me \$18 after a discount of 10% had been allowed?

3. To 3 times a certain number I add 14 and obtain 32. What is the number?

4. Some merchandise was sold for \$151.20, at a loss of 10% on the cost. What per cent would have been made if the goods had been sold for \$194.88?

5. A cloakmaker sold a seal-skin sack at $12\frac{1}{2}\%$ less than cost, and lost \$30. What did he receive for it?

6. Mr. Jones sold a span of horses for \$350, and gained 20%. What per cent would he have gained if he had sold the span for \$70 more than he did?

7. Mr. Allen sold his horse and carriage for \$360, and thereby gained 20% on what they cost him. What per cent would he have gained by selling for \$400?

8. What was the per cent of loss when $\frac{5}{8}$ of an article was sold for $\frac{3}{5}$ of its cost?

9. By selling a house for \$1,530, 15% was lost. What would the house have sold for if the loss had been only 10%?

10. The expenses of a concert were $16\frac{2}{3}\%$ of the receipts. If the profits were \$175, what were the expenses?

11. A shopkeeper marked his goods at 25% above cost. He deducted 20% of the amount for cash. What per cent did he make?

12. A milkman bought an 80-quart can of milk at \$.15 a gallon, and sold it for \$4.80. What was his per cent of profit?

13. A man paid \$6.75 for coal at \$4.50 a ton. What part of a ton had he used when he had used $33\frac{1}{3}\%$ of the whole amount?

DUTIES OR CUSTOMS.

1. Have you ever been in Washington, D.C.?

2. What can be seen there?

3. Name some of the persons engaged in making and executing our laws.

4. Who pays these men for their work?

5. Where does the Government get all its money for all expenses?

Ans. I. From an Internal Revenue, — a tax on the right to make or sell liquors, tobacco, etc. II. From Customs or Duties, — taxes on imported goods.

6. What are imported goods?

7. What goods do we import?

8. Make a list of the more important things that are imported, and the name of the country from which they are imported.

9. Who determines the amount of Duties to be paid?

Ans. The Government, by an Act of Congress, usually called, "The Tariff Act." This is a list of goods on which duties must be paid, with the rate of duty assessed on each.

10. What is Tariff?

11. Where are these duties collected?

Ans. At Custom Houses, — buildings owned by the United States, where the Collector and other officers do business.

12. The Government designates certain places called Ports of Entry, where Custom Houses are built.

13. What are Ports of Entry?

14. Are Ports of Entry ever found except on the sea-coast? Why?

15. What is smuggling?

16. Duties are either specific or *ad valorem.* Specific duties are based on the number, quantity, weight of the merchandise. *Ad Valorem* duties are based on the value of the merchandise.

17. What are Specific Duties?

18. What are *Ad Valorem* duties?

CUSTOM–HOUSE BUSINESS — CONTINUED.

1. Importers are required to submit to the collector an invoice. This is a description of the goods, and their cost in the country from which they are imported.

2. What is an invoice?

3. Allowances, called Tare, Leakage, and Breakage, are deducted before estimating duties.

Tare is a deduction from the gross weight because of the weight of the box, etc. Leakage is an allowance made on liquids in casks or barrels. Breakage is an allowance made on liquids in bottles.

4. Invoices are made out in the money of the country from which the goods are imported. When changed to United States money the duty is computed on the nearest dollar.

5. What is the duty at 35% on 75 pieces of satin, each piece containing 47 yd. at $1.65 a yard?

6. What is the duty on 20 casks of wine containing 40 gal. each, invoiced at $1.12½ a gallon, at 28%, leakage, 5%?

7. A grocer imports 360 bags of cocoa, gross weight 145 lb. each, tare 3½%, invoiced at 13¢ a pound. What was the duty at 2½¢ a pound?

8. What is the duty upon merchandise invoiced at 120 *lira*, allowing 7½% for breakage; rate of duty, 27%? A *lira* is equal to $.193.

9. If the rate of duty is 50%, and tare 2%, find the duty on merchandise invoiced at 4,670 *guilders*. A *guilder* is equal to $.402.

10. Find the duty on 1,150 gal. of brandy, leakage 2%, rate of duty, $1.75 a gallon.

11. At 35% *ad valorem*, what is the duty on 150 doz. pairs of kid gloves invoiced at 68 *francs* a dozen? A *franc* is equal to $.193.

12. What is the duty at 2½¢ a pound on 500 sacks of cocoa, each containing 85 lb., the tare being 1½%?

DUTIES AND CUSTOMS.

1. What is the duty at 30¢ a dozen, and 15% *ad valorem*, on 750 doz. linen collars valued at 88½¢ a dozen?

2. If velvet cloaks cost 600 *francs* each in Paris, and the duty is 50%, what will be the duty on a dozen cloaks?

3. By the last Tariff Act the duty on varnish is 35%, and $1.32 a gal. Find the duty on 6 bbl. of varnish, 31½ gal. to a barrel, invoiced at $6 a gallon, leakage 10%.

4. If the duty on Brussels carpets is 44¢ a square yard, and 40% *ad valorem*, find the total cost to me of 300 yd., ⅔ yd. wide, invoiced at 6*s*. a yard. A shilling is $.243.

5. The duty on an importation of lace at 60% was $624. How many yards were there if the lace was invoiced at 80¢ a yard?

6. What is the duty at 20% on 25 oil-paintings, averaging $1,375, and on 15 pieces of statuary averaging $978 each?

7. What is the duty at 2¢ a pound on 375 boxes of figs, weighing 138 lb. each, tare 16 lb. on each box?

8. What is the duty on 12 casks of molasses, 63 gal. each, at 3¢ a gallon, leakage 15 gal.?

9. The duty on plate glass is 35¢ a square foot. Find the duty on 416 plates, each plate 9½ ft. by 12½ ft.

10. Find the duty at $.65 a cubic foot on a block of Italian marble 2½ by 3½ by 8 ft., invoiced at 3,450 *lira*.

11. Merchandise invoiced at 7,689 *florins* pays a duty of 35%. A *florin* is equal to $.359.

12. At 44¢ a square yd., and 40% *ad valorem*, find the duty on 2,468 yd. Brussels carpet 27 in. wide, invoiced at 3⅓ shillings.

13. A merchant imported 26 hhd. of sugar, invoiced at 1,045 lb. each. What will be the duty, tare being 12½%, and the rate 2¢ a pound?

14. What is the duty on 40 bales of peanuts invoiced at 80 lb. each, tare being 6%, and the duty ½¢ a pound?

1. A butcher bought $7\frac{1}{2}$ doz. turkeys for \$108, and found 20% of them spoiled. How must each one of the remainder be sold to gain $33\frac{1}{3}$% on the lot?

NOTE. — Most merchants choose some word of 10 letters as their private key, thus : $\underset{1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 0}{p\ r\ e\ c\ a\ u\ t\ i\ o\ n}$. Now, if a merchant wishes to mark an article 25¢, he uses the letters *r a*.

2. A merchant's private key for marking goods is "abridgment." If he buys goods at *bd* a yard, how must he mark them so as to gain 20%?

3. Using the same key, how must shoes that cost \$*b.dt* be marked to gain 50%?

4. What is the duty on 224 chests of tea, each weighing 67 lb., tare being 4 lb. to a chest, at \$1.50 a hundred weight?

5. *\$475* *Holyoke, April 1, 1898.*

Three months after date, we jointly and severally promise to pay J. A. Dickinson, or order, Four Hundred Fifty Dollars, with interest. Value received.

John French.
James Fiske.

Is this a negotiable note? What is the meaning of jointly and severally? Find the interest due when the note is legally due.

6. A grocer borrowed \$400 at 6% interest, and bought flour at \$4 a barrel. He kept the flour 1 yr. 3 mo., when he sold it all at an advance of 25%. After paying his note, how much had he gained?

7. What will it cost to build a half mile of road at \$4.75 a rod?

8. How many screws in $5\frac{1}{4}$ gross and $4\frac{3}{4}$ doz.?

9. What will be the cost of 8 bu. 3 pk. 6 qt. of nuts at \$3.20 a bushel?

10. How many feet in $7\frac{1}{3}$ rd., $11\frac{1}{6}$ yd.?

1. How many cubic inches in a sugar-loaf in the form of a cone, the diameter of the base being 8 in., and the height 18 in.?

2. How many cubic feet in a cylinder 60 ft. long, and 8 ft. in diameter?

3. Find the contents of a pyramid whose base is 9 ft. square, and whose altitude is 79 ft.

4. How many board feet in 15 2-in. planks 12 ft. long, 18 in. wide at one end, and 12 in. wide at the other end?

5. How many acres in a field in the form of a triangle whose base is 965 rd., and altitude 576 rd.?

6. A man placed $4,200 insurance on his house, $2,400 on his furniture, and $700 on his library, for 3 yr., paying a premium of $109.50. What was the rate per annum?

7. I paid $50.12½ as premium for insuring my house at 2½%. What was the value of the house?

8. A store valued at $10,000, and a stock of goods valued at $15,000, were insured for 75% of their value at ¾%. If there were a total loss by fire, what would be the owner's loss? Company's loss?

9. A man bought a horse, carriage, and harness for $240. He gave three times as much for the carriage as for the harness, and as much for the horse as he did for both the carriage and the harness. How much did he give for each?

10. A farmer, when asked how many cows he had, replied that if he had twice as many more he would have 60. How many had he?

11. If the interest on $960 at 5% is $54.40, what is the time?

12. A gave his note Aug. 6, 1897, for $670, interest at 7%. He paid the note and interest May 17, 1901. How much did he pay?

13. Find the interest on $9 for 9 yr. 9 mo. 9 da. at 9%.

1. An agent sold 300 bbl. of flour, charging $2\frac{1}{2}\%$ commission, and $2\frac{1}{4}\%$ guaranty; the net proceeds sent the consignor were \$1,143. For how much was the flour sold a barrel?

NOTE. — An agent, by accepting a guaranty in addition to his commission, becomes responsible for the payment of the debt.

2. If I buy at 20% off from list-price, and sell at 25% above list-price, what is my gain on an article listed at \$20?

3. What is the rate of commission when \$393 is received for collecting a bill of \$7,860?

4. The architect who was employed to erect our High School was allowed 4% for plans and specifications and $1\frac{1}{2}\%$ for superintending the construction. If the building cost \$200,000, how much more or less than \$10,000 did he receive?

5. A dealer bought some cloth at \$3.75, and marked it \$*c.cr* $\frac{p}{r}$, his key being "precaution." What was his gain per cent?

6. Using the same key he marked some goods \$*r.an*, and gained at that rate $11\frac{1}{9}\%$ on the cost. What was the cost a yard?

7. A book marked \$1.50 was sold at 25%, 20%, and 10% off. What was the selling-price?

8. What fraction increased by 16% of itself equals $\frac{29}{30}$?

9. A man owning 75% of a mill, worth \$10,000, sold $16\frac{2}{3}\%$ of his share to his brother. What part does he still own? and what is its value?

10. A house was 48 ft. long, 25 ft. wide, and 21 ft. high. Allowing 240 sq. ft. for openings, how many bricks will build the walls, if they are 3 bricks in thickness?

11. A room is thirty feet long, $22\frac{1}{2}$ ft. wide, and 10 ft. 8 in. high. Making no allowance for openings, find the cost for papering at \$1.75 a roll, and of molding at $10\not{c}$ a foot.

12. If $\frac{1}{5}$ of a yard of satin cost \$2.10, how much will $49\frac{1}{2}$ yd. cost?

13. If $19\frac{1}{2}$ tons of iron cost $\$97\frac{1}{2}$, what will $97\frac{1}{2}$ tons cost?

ORAL.

1. What is the result of an example in subtraction called?

2. (*a*) A man had \$25, and lost \$10. (*b*) You have \$25, and I have \$10. In (*a*) is the answer a difference or remainder? In (*b*)?

3. What kind of numbers can be subtracted?

4. When numbers are unlike, what must be done before subtracting?

5. When fractions are unlike, what must be done before subtracting?

6. What are the terms in subtraction called?

In the following four examples, give the answer in terms of both the minuend and subtrahend:

7. 3 lb. − 32 oz. 4 hr. − 180 min. 4 yr. − 36 mo.

8. 5 yd. − 12 ft. 5 ft. − 48 in. 9 ft. − 2 yd.

9. \$12 − 350¢. 2 T. − 2000 lb. 5 dimes − 20 ct.

10. 4 bu. − 8 pk. 6 pk. − 24 qt. 10 qt. − 8 pt.

11. Find the missing term:

Minuend,	45	x	43	53	x	61	x	95	74
Subtrahend,	x	36	27	x	34	29	64	x	39
Remainder,	24	15	x	11	42	x	19	32	x

12. In the morning I had \$2, during the day I spent 35 cents, a half-dollar, a quarter, and a dime. How much money had I at night?

13. What day of what month is the 75th day of every year not a leap year? What change does leap year make?

14. What number is 12 less than 76 − 38?

15. What kind of numbers can be compared?

16. What are the terms of a ratio called?

17. When do you have a fraction for your ratio? When an integer?

18. What effect on an integer is made by annexing a cipher? By dropping a cipher?

TAXES.

1. Mention several things for which a city or town needs money.

2. Where does the money for schools, roads, sewers, lights, police, etc., come from? *Ans.* From taxes.

3. What is a tax? *Ans.* A tax is a sum of money assessed on persons and owners of property to meet the expenses of a town, city, county, or State.

4. Find out what need a county has for money.

5. Find out what need a State has for money.

6. Poll means head. What, then, is a poll-tax?

7. Who pays a poll-tax?

8. Does a man need to own any property in order to be assessed a poll-tax?

9. How many kinds of property are there? *Ans.* Real Estate and Personal Property.

10. Real Estate consists of lands, houses, or, in general, immovable property, and is taxed in the place where it is situated.

11. Personal Property consists of horses, money, merchandise, etc., or, in general, movable property, and is taxed in the place where the owner lives.

12. Any tax upon Real Estate or Personal Property is called a Property tax.

13. Assessors are persons appointed to make an Inventory of all taxable property and estimate its value.

14. How large a poll-tax is assessed in your town or city?

15. How large a tax on property is assessed in your town or city?

Taxes are usually assessed and collected as follows:

16. The State determines the amount to be expended for State purposes, and divides that amount among the counties according to their valuation, previously determined.

17. The county adds to this sum the amount it will need for county expenses, and divides the total among the towns of the county according to their valuation.

18. Each town adds to this amount whatever it needs for schools, police, roads, salaries, etc., and thus finds its total tax, or Tax Levy.

19. The assessors now find the number who must pay a poll-tax, and multiply this by the tax on one poll. This is the poll-tax, and is subtracted from the whole tax. The amount of the tax that is left must be assessed on property, and is called the Property Tax.

20. The assessors now find the entire valuation of the town by adding all the Real Estate and Personal Property. This is called the Total Valuation.

TAXES — CONTINUED.

1. If the tax that is to be raised on the property is now divided by the property, what will the result be? This tax on $1 is called the tax-rate.

2. The assessors had to find the amount of property each man owned when they found the valuation of the town. If the sum of money that each man owns is multiplied by the tax-rate, what will be the result?

3. In some States the county and State tax are found separately, and are not united with the town tax.

4. Write the different steps taken in computing taxes, and tell the reason for each step.

5. Do you see the reason why all persons are not taxed the same amount?

6. Sometimes there is assessed an Income tax; that is, a tax on a man's income.

7. Sometimes, to provide for abatements and uncollected taxes, the property tax is increased by a small percentage.

8. There are 4,120 persons, each of whom pays $1.50 in the city of B. The total valuation is $5,864,528, and the total tax $94,147.92. What must Mr. Philips pay, who owns a mill valued at $4,500, and who owns personal property valued at $1,240?

9. The property valuation of a town is $1,500,000, and the tax levy is $12,500. There are 250 male adults, each paying $2. Mr. Dunbar's real estate is valued at $7,500 and his personal property at $4,500. Find his tax.

10. In the town of C there are 2,500 polls, each taxed $2. The tax levy is $245,000 and the taxable property $12,000,000. Find Mr. J's tax on property worth $125,000.

11. A tax of $50,000 is levied in a town, valued at $3,200,000. There are 1,000 persons who pay a poll-tax of $2. What is my tax if my property is valued at $9,000?

12. In the city of H there are 1,200 male adults, each poll taxed $1. The taxable property is $30,000,000 and the tax levy $151,200. What tax does Mr. Sims pay who is assessed $12,000 for real estate, and $2,500 for personal property?

13. The real estate of a city is $3,099,500; personal property, $1,487,280; tax levy, $66,023.92. 1,340 polls are each assessed $1.35. What does Mr. A pay, whose property is valued at $18,000?

NOTE. — In all these examples a poll-tax is included in finding the whole amount of a man's tax.

TAXES.

1. What is the rate of taxation in a city when $125 is the tax on a house assessed at $6,000?

2. How much tax will a man pay on $6,250 if the rates are $1\frac{1}{8}\%$ for a city tax, and $\frac{3}{8}\%$ for State and county tax?

3. If the tax-rate is 21 mills on a dollar, what is the assessed value of a property that pays $62,622 tax?

4. The valuation of the town of H is $2,432,500, and the tax-levy is $48,650. Mr. Smith owns $150,000 worth of property, assessed at $\frac{2}{3}$ of its value. What is his whole tax?

5. If a tax-rate of $2\frac{1}{2}¢$ on a dollar produces $130,000, what is the assessed valuation of the property?

6. What is the rate of taxation when $2,285.10 is the tax upon $152,340?

7. The property of a town is $210,000. Mr. Miller is worth $4,168.50. What special tax must he pay toward building a schoolhouse costing $3,500?

8. The assessed valuation of the property of a town is $2,242,000. The amount needed for special purposes is $11,210. What is the tax of Mr. Reynolds, whose property is assessed $8,476?

9. Find the rate of taxation when $46,427.55 is to be raised on a valuation of $15,475,850.

10. How much of a total tax of $4,189.50 must Mr. S. pay, who owns $24,000, out of a total valuation of $1,675,800?

11. There are 200 taxable polls in the town of Sheffield, each assessed $2. The expenses of the town are $16,150, and the valuation of the property, $1,750,000. Mr. Mellen owns $2,460 worth of property. Find his tax, including one poll.

12. The assessed valuation of a city is $10,500,000. The money to be raised is $147,000. What is the rate?

13. A man's real estate is $6,500. Rate, 3 mills on a dollar. Find the amount of his tax if allowed 2% for prompt payment.

1. A rectangular field is 215.11 ft. long, and its length 7 times its width. Find its perimeter and area.

2. A man started in business with $3,200. The first year he gained 15%, the next he lost 20% of what he then had; the third he gained 12½% of his capital for that year. How much had he then?

3. The expenses to be paid for by taxation in a certain village are $9,600. The valuation of the village is $480,000. If Mr. Davis pays $170.80 as a tax, for how much is his property assessed?

4. A buys a house for $6,000, and sells it to B at a gain of 20%. B sells it to C at a loss of 20%. What per cent of A's gain is equal to B's loss?

5. The sum of A's, B's, and C's salaries is $6,000. A's salary is 33⅓% more than B's; and C's is 25% more than A's. Find the salary of each.

6. A bin 12 ft. long, 3 ft. 2 in. wide, and 6 ft. high, was filled with apples. 25% of them spoiled, and the remainder were sold at 25¢ a peck. How much was received for the apples?

7. In an election A received a certain number of votes, B received 35 more than twice as many, and C 75 less than 3 times as many. The total vote was 2,810; how many did each receive?

8. 54 yd. of cloth, 1¼ yd. wide, cost $5.40; what will 45½ yd. of cloth cost if it is ⅞ yd. wide?

9. A rectangular lot of land is 242 ft. by 72 ft. What decimal part of an acre is it?

10. What will be the amount of $1,847 at 8% from June 6, 1897, to Dec. 21, 1906?

11. A speculator sold 3,400 bbl. of flour at $5.00 a barrel, with a discount of 8% and 2½%. Find the net proceeds.

12. Find the cash value of a bill of goods amounting to $2,375.50 at 10% discount and 5% off for cash.

1. What principal will amount to $438.50 in 1 yr. 9 mo. at 5½%?

2. What is the duty, at 15%, on 640 yd. of silk invoiced at $2.25 a yard?

3. What is the duty, at 12¢ a cwt., on 36 bags of salt, each containing 115 lb., tare 2 lb. a bag?

4. How much tax will a person pay whose property is assessed $246,500, if he pays 1¾% city tax, 1% school tax, ¾% county tax?

5. Real estate of a town, $1,105,843; personal property, $249,031; tax to be raised, $21,258.11. There are 850 polls, each assessed $1.10. What tax will Mr. Martin pay if his property in the town is assessed for $8,650, and he, not being a resident of the town, pays no poll-tax?

6. An insurance company took a risk of $375,000 at ⅘%. It reinsured $175,000 in another company at 1%. How much premium did it clear above what it paid?

7. When the rate of insurance is 3½% and the premium $14.63, what is the value of the property insured?

8. The premium for insuring a house at ¾ of its value was $54.60. If the rate was 1⅝%, for what amount was the house insured?

9. A note for $1,460 was given, to be paid in 1 yr. 7 mo. 21 da., with interest at 6%. What was the amount due at the expiration of the time?

10. What number increased by 22% of itself is 23,546?

11. A horse and carriage were sold at a profit of 20%, which was a gain of $100. The horse cost 50% more than the carriage. What was the cost of each?

12. I sold 75 bu. of wheat at $1.05 a bushel. This was 5% more than I paid for it. How much did I gain?

13. What part of 6 rd. is 14 yd. 2 ft.?

14. Write a promissory demand note.

1. A room is 17 ft. 9 in. long, 14 ft. 4 in. wide, and 10 ft. high. There are three windows, each 6 ft. by 4 ft. 4 in.; and 2 doors, each 7 ft. 3 in. by 5 ft. 9 in.; a base board 9 inches high.

a. Find the cost of lathing walls and ceiling, laths costing 50¢ a bundle, and the cost of laying 35¢ per M.

b. Find the cost of boards $\frac{3}{4}$ in. thick for a double floor, at $16.25 per M.

c. Find the cost of plastering at 22¢ a square yard.

d. Find the cost of papering, paper 35¢ a roll, and border 12¢ a foot.

e. Find the cost of carpet, 27 in. wide, breadths running lengthwise, loss 9 in. on a breadth for matching, costing $1.87\frac{1}{2}$ a yard.

2. How many gallons of water can be put in a cubical cistern, whose edge is 10 ft.? In a circular one, 10 ft. high and 10 ft. in diameter?

3. The circumference of a dome in the shape of a hemisphere is 94.248 ft. At 25¢ a square inch, find the cost of gilding it.

Find the approximate cost mentally, then by figures test your work:

4.	15 lb. @ 15¢;	32 qt. @ 18¢;	$24\frac{1}{4}$ lb. @ 8¢.
5.	12 cwt. @ 60¢;	46 gal. @ 20¢;	14 gal. @ 32¢.
6.	9 bbl. @ $4.50;	86 qt. @ 8¢;	88 yd. @ 15¢.
7.	$22\frac{1}{4}$ A. @ $30;	$13\frac{3}{4}$ lb. @ 16¢;	58 oz. @ 25¢.
8.	$18\frac{1}{2}$ doz. @ 24¢;	16.4 T. @ $8;	$28\frac{3}{4}$ cd. @ $8.
9.	246 yd. @ 7¢;	$24\frac{1}{2}$ bu. @ 75¢;	$14\frac{1}{4}$ gal. @ 28¢.
10.	16 yd. @ $1.87\frac{1}{2}$;	98 qt. @ 7¢;	$5\frac{1}{4}$ cwt. @ $1.20.
11.	$5\frac{1}{2}$ bbl. @ $4.60;	212 oz. @ 6¢.	98 cd. @ $4\frac{1}{2}$.

12. In a store the key by which goods are marked is "precaution." The letters above the line denote cost; below the line selling-price. Find x, when the gain is 20%.

$$\frac{pa}{x};\quad \frac{x}{rc};\quad \frac{p.ra}{x};\quad \frac{in}{x};\quad \frac{x}{e.un};\quad \frac{x}{pr};\quad \frac{c.an}{x}.$$

13. Using key, find gain or loss per cent:

$$\frac{ca}{an};\quad \frac{on}{rp};\quad \frac{a.nn}{c.un};\quad \frac{e.au}{c.ca};\quad \frac{au}{rn};\quad \frac{r.cn}{e.un}.$$

1. If an article is bought at 25% less than its value, and sold at 25% more than its value, what is the gain per cent?

2. Find the cost of a farm of 350 acres which is sold at $20.50 an acre, which is 25% more than its cost.

3. What is the interest on $789.80 for 3 yr. 5 mo. 24 days at 7%?

4. 305 rd. 4 yd. 7 ft. 9 in. is what decimal part of a mile?

5. Find the cost of 978 bbl. of flour on which, when sold at $5.70 a bbl., 14% was gained.

6. If the profits of a mill are $8,184 in two years, and the profits for the second year are 20% more than the profits for the first year, what are the profits for each year?

7. A certain farm is half a mile wide, and its two parallel sides are 120 rd. and 80 rd. respectively. Within this farm is a circular pond 24 rd. in diameter. Find the acres of serviceable land in the farm.

8. A cube measures 18 in. on a side, and a cylinder measures 18 in. in diameter and altitude. What is the difference in their surfaces?

9. Compare the contents of a sphere 24 in. in diameter with that of a cylinder, diameter and altitude each 24 in.

10. On the 6th of January, 1897, A borrowed $768 at 7½%. How much will he owe me June 21, 1899?

11. A, B, and C earned $8,580. A earned twice as much as B, and B earned four times as much as C. How much did each earn?

12. A pile of wood contains 12 cd. It is 32 ft. long, and 4 ft. wide. How high is it?

13. What will 37½ bu. of wheat cost when 10.25 bu. cost $8.20?

14. Add two thousand three hundred forty-one and seventeen thousandths; four hundred twelve and nine thousandths; six and three tenths; sixty-one and fourteen ten-thousandths.

1. If $\frac{7}{11}$ acres of land cost $\$18\frac{7}{11}$, how much must be paid for $78\frac{3}{5}$ A.?

2. What is the volume of a cone whose altitude is 42 in. and whose diameter is 24 inches?

3. If a man can do a piece of work alone in 5 days, and, with the help of a boy, in 4 days, how long will it take the boy to do it alone?

4. What are the prime factors of 32,320?

5. A man failed in business, and, after paying 60% of his liabilities, found that he needed $3,500 to free him from debt. Find his whole indebtedness.

6. What is the ratio of 30 rd. 15 ft. to 3 miles?

7. What is the interest on $879.76 for 5 yr. 9 mo. 14 da. at 8%?

8. At what rate will $100 gain $15 in 2 yr. 6 mo.?

9. In what time will $700 gain $299.95 at 6%?

10. If a man owns $\frac{5}{8}$ of a mill, and sells $\frac{2}{5}$ of his interest for $4,000, what is the value of the mill?

11. If the ratio is 7, the consequent 1 week, 4 days, 6 hours, what is the antecedent?

12. What is the duty on 900 boxes of raisins, each box weighing 48 lb., invoiced at 15¢ a pound, duty 28% *ad valorem?*

13. Reduce $\frac{7}{8}\frac{5}{6}\frac{3}{5}$ to a decimal.

14. $338\frac{3}{4}$ lb. of sugar cost $27.10. How many pounds can be bought for $197.36?

15. How many rails of the longest equal length will inclose a triangular field the sides of which are respectively 372 ft., 474 ft., and 582 ft.? At $2.50 a panel, what will it cost to build the fence? A panel is the distance from post to post, or the length of the rails used.

16. What is the smallest quantity of grain that will exactly fill an exact number of bins, whether they hold 35, 63, 91, or 119 bushels?

1. The product of three numbers is 2,090; one is $28\frac{1}{2}$ and another 22. What is the third number?

2. Find the sum, difference, product, and quotient of $\frac{4}{5}$, $\frac{5}{6}$, using the larger fraction as minuend and dividend.

3. Divide the least common multiple by the greatest common divisor of 18, 48, 72, 66.

4. If $61\frac{1}{2}$ lb. of tea cost $\$55\frac{7}{20}$, what is the cost of $217\frac{3}{10}$ lb.?

5. What number increased by $\frac{1}{2}$ of itself will produce $37\frac{1}{2}$?

6. If an agent receives $2\frac{1}{2}\%$ for collecting, and is paid \$739, how much will his employer receive?

7. A sold some goods to B at a profit of 10%. B sold them to C at a profit of 10%. C sold them to me at a profit of 20%. Now, if I paid \$1,452, what did they cost A? Had A sold directly to me at the price I paid C, what per cent would he have made?

8. If a broker sells goods that cost \$4,800 at a profit of 6%, and charges 5% on the amount received as commission, how much does the owner of the goods receive as profit?

9. A gentleman bequeathed $\frac{1}{3}$ of his estate to his wife, $\frac{1}{4}$ of the remainder to his eldest son, and $\frac{1}{5}$ of what then remained to his two daughters, each of whom received $\$342.33\frac{1}{3}$. What was the value of the estate?

10. How many cubic yards of earth will be thrown out in digging a ditch 3 ft. deep and 4 ft. wide just within the boundary of a rectangular field 12 rd. long and 8 rd. wide?

11. Change 7 da. 3 hr. 12 min. 26 sec. to seconds.

12. Change 616,346 sec. to minutes, hours, etc.

13. Express .035, .625, .12288 as common fractions in their lowest terms.

14. If a piece of cloth contains 246 yd. 1 ft. 6 in., how many times can you cut from it 14 yd. 1 ft. 6 in.?

15. Reduce $\frac{11}{16}$, $\frac{18}{125}$, and $\frac{602}{625}$ to decimals.

16. Express .88125 cwt. in pounds and ounces.

INTEREST.

1. Find the interest of $4,378 for 3 yr. 8 mo. at 5%.

2. Find the interest of $426.25 for 20 yr. 9 mo. 24 da. at 6½%.

3. Find the interest of $417.16 for 4 yr. 11 mo. 17 da. at 4%.

4. A has $16,000, and loans 12½% of it to B for 2 yr. 3 mo. 7 da. at 4½%. How much does B owe him at the expiration of the time?

5. Find the interest of $900 for 93 days at 7%.

6. A man bought 43 cows at $38.50 each, and paid half cash and the remainder in a note for 2 yr. 4 mo. at 3½%. What was due on the note at maturity?

7. Find the amount of a note for $916.84, given Aug. 16, 1898, at 6½%, and due Mar. 11, 1901.

8. A man bought a horse Oct. 3, 1898, for $186, and gave in payment his note at 7%. On June 13, 1899, he sold the horse for $192.50, and paid his note in full. How much did he gain or lose?

9. What principal on interest at 6% will gain $105 interest in 3 yr. 6 mo.?

10. Interest $21.69⅔, time 2 yr. 4 mo. 9 da., rate 5%. Find the principal.

11. At what rate will $3,470, give $1,408.82 interest in 6 yr. 9 mo. 6 da.?

12. A man gave his note Jan. 11, 1899, for $6,000 at 5%. Sometime afterward he canceled the note by paying $9,326.66. What was the date of cancellation?

13. Write a note supplying all the data.

14. John James paid Amos White, of Salem, Mass., Sept. 1, 1898, $112.24, amount due for meat. Write the receipt in full.

15. I loaned a friend $8,000 June 16, 1897. If money is worth 6½%, how much is due me Sept. 1, 1900?

1. Sold 140 boxes of glass at $5 a box, with 60% and 30% off. What did I receive for it?

2. Paid $50 for insuring property worth $15,000 at the rate of 50¢ on $100. What part of the value of the house was insured?

3. If I ask for a house 20% more than it cost me, but afterwards make a reduction of 10% from the asking price, and thus receive $4,320, what did the house cost me?

4. By selling butter at 30¢ a pound on 4% commission, an agent received $72. How many pounds of butter did he sell?

5. If it cost $1,296 to board 12 persons 18 weeks, how much will it cost to board 30 persons 8 weeks?

6. A grain-dealer bought 12,000 bu. of oats at $33\frac{1}{3}$¢ a bushel, and 20% of them spoiled. For how much must he sell the remainder a bushel to make a gain of 20%?

7. If $\frac{4}{5}$ of the selling-price is 40% less than the cost, what is the per cent of loss?

8. If $\frac{4}{5}$ of the selling-price is 10% less than the cost, find the per cent of gain.

9. The assessed valuation of a town is $800,000 and the tax $10,000. What is the tax on property assessed at $8,250?

10. A man buys 1,200 bbl. of apples at $2.40 a barrel. He pays 20¢ a barrel for freight, and 5¢ a barrel for storage. He sells them at $3.20 a barrel. What was his entire gain if he pays 1% commission for buying, and the same for selling?

11. What is the difference between a discount of 20% and 20%, and one of 25% and 15%?

12. If the rate of insurance is 30¢ on $100, and my premium is $24 on $\frac{3}{4}$ of the value of my house, what is its value?

13. A can do a piece of work in $6\frac{1}{4}$ days; B can do it in $8\frac{1}{3}$ days. In what time will they both do it working together?

14. What rate per cent does a merchant make who sells apples which cost $2.80 for $3.50?

ORAL.

1. What is the area of a triangle whose base is 15 ft. and altitude 12 ft.?

2. The area of a triangle is 160 square feet, and the base is 16 ft. What is the altitude?

3. What is the area of a rectangle whose base is 15 ft. and altitude 12 ft.?

4. If 10 tons of coal cost $55, what will 12 tons cost?

5. The rate of taxation in the town of C. is $1\frac{1}{2}\%$. What is the tax of Mr. A., whose real estate is valued at $3,000 and personal property at $1,000?

6. The rate of taxation is $1\frac{3}{5}\%$. What is John Smith's tax if he is worth $5,000?

7. The goods in my store are worth $3,000. I insure them for $\frac{2}{3}$ of their value at $\frac{1}{2}\%$ premium. What will be my loss if the goods burn? What will be the loss of the insurance company?

8. At 6% find the interest for 18 days:

$40	$210	$2,400	$16,000
$50	$160	$1,200	$15,000
$60	$540	$1,000	$48,000
$70	$250	$4,400	$64,000

9. A man worth $6,000 bequeathed $33\frac{1}{3}\%$ of it to a benevolent institution and divided the rest equally among his wife and three children.

10. What per cent do I gain if I sell for $3 a watch-chain that cost me $2.50?

11. Can you lose 150% on an article? Can you gain 150%?

12. Divide:

.273 by 3	.24 by .2
.45 by .5	6.25 by .5
.250 by .5	4000 by .04

13. $\frac{2}{3}$ of 36 are $\frac{4}{5}$ of what number?

COMPOUND INTEREST.

1. What is a savings bank?

2. How many of you have money in a savings bank?

3. Why is it a good plan to put money in a bank?

4. Suppose you each put $200 in a savings bank Jan. 1, 1898, and the bank pays 4% interest. How much interest will be due Jan. 1, 1899?

5. To whom does this $8 belong?

6. If you go to the bank Jan. 1, 1899, and the bank pays you $8, how much money will you have in the bank for the next year?

7. If you do not call for the $8, what will be done with it by the bank officials?

8. If the $8 is added to your $200, how much money will you have on interest the second year?

9. What will be the interest of $208 for the second year?

10. When the interest is added to the principal, so as to find interest on principal and interest, it is called Compound Interest.

11. Interest at savings banks is usually compounded semi-annually. Sometimes quarterly. Compound annually unless otherwise directed.

12. In the 9th question what will be done with the $8.32?

13. How much will you have on interest then?

14. How much will the interest be the third year?

15. What will be the new principal for the fourth year?

16. This example is worked like the following:

$200.00	1st Principal.
8.00	Interest for 1st year.
$208.00	Principal for 2d year.
8.32	Interest for 2d year.
$216.32	Principal for 3d year.
8.653	Interest for 3d year.
$224.973	Amount in bank at end of 4th year.
200.00	1st Principal.
$24.973	Compound Interest for 3 years.

COMPOUND INTEREST.

1. Formulate a rule for compound interest.

2. What is the compound interest of $450 for 4 yr. 3 mo. 15 da. at 4%?

3. What is the difference between the simple and compound interest of $500 for 5 yr. 6 mo. 18 da. at 6%?

Find the compound interest of the following:

4. $4,500 for 2 yr. 6 mo. at 3½%.

5. $1,278 for 3 yr. 9 mo. at 4%.

6. $2,576 for 4 yr. 2 mo. 12 da. at 5%.

7. $1,563 for 5 yr. 3 mo. 21 da. at 4½%.

8. $6,793 for 3 yr. 6 mo. 15 da. at 4%.

9. $728 for 2 yr. 9 mo. 24 da. at 3%.

10. $1,560 for 6 yr. 6 mo. 6 da. at 6%.

11. Find the compound interest of $600 for 1 yr. 9 mo. at 4% annually, compounded semi-annually.

NOTE. — 4% is the annual rate. The rate for 6 mo. would be what?

12. Find the compound interest of $550 for 1 yr. 4 mo. 12 da. if compounded quarterly at 1% a quarter.

Find the difference between the simple and compound interest of:

13. $1,678 for 2 yr. 5 mo. 19 da. at 6%.

14. $2,768 for 3 yr. 3 mo. 3 da. at 3%.

15. $1,248 for 4 yr. 4 mo. 4 da. at 4%.

16. $678 for 3 yr. 11 mo. 21 da. at 4½%.

17. $624 for 5 yr. 7 mo. 21 da. at 5%.

18. $4,635 for 2 yr. 4 mo. 15 da. at 3½%.

19. $6,745 for 3 yr. 9 mo. 17 da. at 4%.

20. $5,476 for 4 yr. 5 mo. 13 da. at 5%.

21. $4,124 for 3 yr. 3 mo. 3 da. at 6%.

22. $2,146 for 4 yr. 4 mo. 4 da. at 4%.

23. $1,486 for 5 yr. 5 mo. 5 da. at 5%.

24. $4,238 for 3 yr. 8 mo. 18 da. at 6%.

Use the following Table in working the examples in this lesson.

TABLE,

Showing the amount of $1 at compound interest from 1 year to 20 years, at 4, 5, 6, 7, and 8 per cent.

Years.	4 Per Cent.	5 Per Cent.	6 Per Cent.	7 Per Cent.	8 Per Cent.
1	1.040000	1.050000	1.060000	1.070000	1.080000
2	1.081600	1.102500	1.123600	1.144900	1.166400
3	1.124864	1.157625	1.191016	1.225043	1.259712
4	1.169859	1.215506	1.262477	1.310796	1.360489
5	1.216653	1.276282	1.338226	1.402552	1.469328
6	1.265319	1.340096	1.418519	1.500730	1.586874
7	1.315932	1.407100	1.503630	1.605782	1.713824
8	1.368569	1.477455	1.593848	1.718186	1.850930
9	1.423312	1.551328	1.689479	1.838459	1.999005
10	1.480244	1.628885	1.790848	1.967151	2.158925
11	1.539454	1.710339	1.898299	2.104852	2.331639
12	1.601032	1.795856	2.012197	2.252192	2.518170
13	1.665074	1.885649	2.132928	2.409844	2.719624
14	1.731676	1.979932	2.260904	2.578534	2.937194
15	1.800944	2.078928	2.396558	2.759032	3.172169
16	1.872981	2.182875	2.540352	2.952164	3.425943
17	1.947901	2.292018	2.692773	3.158815	3.700018
18	2.025817	2.406619	2.854339	3.379932	3.996020
19	2.106849	2.526950	3.025600	3.616528	4.315701
20	2.191123	2.653298	3.207136	3.869685	4.660957

1. Find the compound interest of $700 for 14 yr. at 4%.

2. What is the amount of $2,200 at 6% compound interest for 15 yr. 6 mo.?

3. What is the compound interest of $480 for 17 yr. 3 mo. 3 da. at 5%?

Note. — Find the interest for the years by the table, and for the months and days as usual.

4. Find the compound interest of $1,850 for 9 yr. 6 mo. at 4%.

5. What is the interest, compounded at 5%, on $1,865 for 7 yr. 7 mo. 18 da?

6. Find the compound interest of $75 for 13 yr. 9 mo. at 6%.

7. Find the compound interest of $300 for 12 yr. 3 mo. 15da. at 4 %.

1. How many yards of carpeting 27 in. wide will be required for a room 27 ft. 6 in. by 20 ft. 6 in., if the breadths run lengthwise, and there is a loss of 9 in. on a breath for matching?

2. A cubical cistern measures 9 ft. How many gallons of water will it hold? How many square feet of sheet iron will it take to line it?

3. Make out a bill containing 10 items bought at a grocery store.

4. A can do in 4 days a piece of work that requires B 6 days, and C 8 days. In how many days can they all do it, working together?

5. A man sold 5,000 bu. of wheat for $320 less than it cost him, and thereby lost 12%. What did it cost him a bushel?

6. A ship valued at $6,000 was insured for $\frac{3}{4}$ of its value at $2\frac{1}{2}\%$. If the ship is lost, what is the total loss to the owners?

7. A town whose valuation is $4,900,000 raises by taxation $63,210. There are 980 poll-tax payers, each taxed $2. What is Mr. Brown's tax, who owns a farm valued at $3,200, personal property amounting to $1,800, and who pays one poll-tax?

8. A man imported from France 12 doz. pairs of gloves, invoiced at 6 francs a pair. The duty was $2.25 a dozen and 50% *ad valorem*. What did the gloves cost him? A franc is $.193.

9. Find the duty on 1,000 boxes of cigars weighing 2,480 lb., invoiced at $3.50 a box; tare, 8 oz. a box; duty, $2.50 a pound and 25% *ad valorem*.

10. An agent paid $58.50, at 2%, for insuring 1,000 bbl. of flour. If the flour was insured for 75% of its cost, what was the cost?

11. An agent sells buggies for $76 each. If the rate of his commission is 15%, how many must he sell to earn $1,026?

12. Find the interest of $1,647 from Sept. 13, 1897, to July 21, 1899, at $4\frac{1}{2}\%$?

13. At what rate will $860.50 gain $103.26 in 1 yr. 4 mo.?

MEASUREMENTS.

1. Find the area of a paralellogram 15 in. by 9 in.

2. Find the area of a rhomboid whose base is 42 ft. and whose altitude is 16 ft.

3. Find the area of a trapezoid whose parallel sides are 14 ft. and 10 feet, and whose altitude is 12 ft.

4. Find the cost of gilding a ball 50 in. in diameter at 5¢ a square inch.

5. Find the volume of a cone if its height is 18 in. and the diameter of its base 20 in.

6. Find the number of gallons contained in a cask whose bung diameter is 24 in., head diameter 22 in., and length 28 in.

7. Find the volume of a cone whose base contains 57 sq. in., and whose height is 28 in.

8. Find the number of bushels of grain required to fill a bin $14\frac{1}{2}' \times 8\frac{1}{2}' \times 4'$.

NOTE. — The signs ′ and ″ are sometimes used in place of feet and inches.

9. Find the number of gallons of water in a well $4\frac{1}{2}$ ft. in diameter if the water is 9 ft. deep.

10. How many feet board measure in 20 beams $8'' \times 10''$ and 24′ long?

11. How many feet board measure in 48 boards $\frac{7}{8}$ in. thick, 4 in. wide, and 15 ft. long?

12. What is the height of a pile of wood containing 50 cords, if it is 400 ft. long and 4 ft. wide?

13. A canal was dug 300 ft. long, 15 ft. wide, and 10 feet deep; how many loads of earth were removed?

14. Estimate the number of bricks required for the walls of a building $80' \times 50' \times 22'$, if the walls are $1\frac{1}{2}$ ft. thick, and if 500 cu. ft. are allowed for doors and windows.

15. The rafters of a house are 21 ft. in length. If the house is 36 ft. long, how many shingles, laid 4 in. to the weather, will be needed?

COMMON FRACTIONS.

1. Reduce to whole or mixed numbers: $\frac{24}{69}\frac{2}{}$; $\frac{15}{55}\frac{3}{}$; $\frac{19}{13}\frac{6}{}$; $\frac{5}{17}\frac{51}{}$.

2. Reduce to improper fractions: $47\frac{2}{3}$; $96\frac{1}{13}$; $13\frac{7}{19}$; $41\frac{27}{100}$.

3. Find product of: $\frac{1}{9}\frac{1}{} \times 549$; $\frac{2}{12}\frac{5}{} \times 108$; $\frac{15}{32} \times 384$; $\frac{4}{25} \times 500$.

4. Find product of; $\frac{14}{50} \times \frac{75}{91}$; $\frac{7}{8}$ of $\frac{8}{15}$ of $\frac{25}{}$; $22 \times 6\frac{7}{11}$.

5. Find the value of: $\frac{5}{9}$ of $3\frac{1}{3}$ of $\frac{6}{25} \div 5\frac{1}{2}$.

6. $97\frac{1}{2}$ is $\frac{13}{17}$ of what number?

7. $89\frac{3}{5}$ is $\frac{14}{25}$ of what number?

8. 99 is $\frac{1}{8}$ more than what number?

9. If $\frac{19}{12}$ of a cord of wood is worth \$5, find the cost of $9\frac{3}{3}$ cd.

10. Find the sum of $\frac{8}{15}$, $\frac{7}{10}$, $\frac{5}{8}$, $\frac{6}{25}$.

11. Find the sum of $26\frac{3}{15}$, $37\frac{9}{10}$, $16\frac{1}{6}$, $48\frac{3}{5}$.

12. From $41\frac{33}{36}$ take $11\frac{7}{8}$.

13. What number must be added to $18\frac{5}{6}$ to make $24\frac{7}{9}$?

14. A can do a piece of work in 15 days, B in 18 days, and C in 12 days. How many days will it take the three together to do the work?

15. If a man walks $3\frac{3}{4}$ miles an hour, how many hours will it take him to walk $187\frac{1}{2}$ miles?

16. A man raised $187\frac{1}{2}$ bu. of barley on $7\frac{3}{4}$ acres of land. How many bushels an acre did he raise?

17. From 120 acres of land, $44\frac{1}{5}$ A. were sold to one man, and $\frac{1}{3}$ of the remainder to another. Find the value of the unsold acres at \$65 an acre.

18. $\frac{5}{7}$ of $\frac{3}{5}$ of the value of a pair of horses is \$210. What is the value of the pair?

19. A can do a piece of work in 6 days, B in 8 days, and C in 10 days. How much of it can they do in 2 days, working together?

20. At $16\frac{1}{4}¢$ a yard, what will $415\frac{2}{3}$ yd. of cloth cost?

PERCENTAGE.

1. What is 138% of 64.6?

2. 210 is $16\frac{2}{3}\%$ more than what number?

3. \$174.72 is 28% of what sum?

4. A merchant dropped \$4.65 from his price on a chamber-set by taking off 15% from his price. What was the price asked?

5. Find the net amount of a bill of \$642 with $\frac{1}{3}$ and 10% off.

6. What is paid for an article listed at \$2.40, and sold at 25% and 10% off?

7. A man offered for sale a piece of land that cost him \$660 so as to gain 40%. He discounted his price $16\frac{2}{3}\%$. How much did he receive for it?

8. A man built two houses at a cost of \$2,785 each. He sold one at a gain of 16%, and the other at a loss of 5%. What was his gain?

9. A commission merchant sold 7,500 bu. of wheat at 65¢, charging $2\frac{1}{2}\%$ commission. How much money should he remit to his principal or employer?

10. Find the cost of insuring a stock valued at \$4,685, risk being taken at $1\frac{1}{4}\%$ on $\frac{3}{5}$ of its value.

11. What would be the tax on \$1 if \$5,838 must be raised on \$486,500?

12. Find the duty at 20% on 348 doz. of olives, invoiced in Italy at 4 *liras* per dozen. (*Lira* = \$.193.)

13. Find the interest on \$476.50 for 3 yr. 7 mo. 4 da. at 8%.

14. Find the amount of \$726.50 for 3 yr. 4 mo. at 4%, compound interest.

15. What principal will amount to \$570 in 2 yr. 4 mo. at 6%?

16. I received \$73.35 as interest on \$326 for 5 yr. What was the rate?

17. \$7.44 is the interest at 5% on \$49.60 for how long a time?

1. If $82\frac{1}{2}$ acres of land cost \$9,900, what will $240\frac{1}{2}$ acres cost?

2. If $18\frac{3}{4}$ tons of iron cost \$285, how much will $10\frac{8}{16}$ tons cost?

3. What number diminished by $\frac{2}{5}$ and $\frac{3}{7}$ of itself equals 210?

4. Divide $998\frac{7}{16}$ by 56.25.

5. The goods in a store, valued at \$17,600, were damaged by fire, but 60% were saved. A owned 40%, B, 35%, and C the remainder of the stock. What was the value of each one's share of the goods saved?

6. Reduce 900 in. to yards and feet.

7. A rectangular piece of land is 12 rd. 8 ft. long and 9 rd. 4 ft. wide. How many acres and rods does it contain?

8. How many 2-ft. cubes can be cut from a block $8' \times 6' \times 4'$?

9. At 80¢ a gallon, how much will 6 gal. 2 qt. 1 pt. cost?

10. How many sheets of paper will be required to make an 8vo volume of 360 pages?

11. What is the ratio of 191 lb. 10 oz. to 27 lb. 6 oz.?

12. Two men, C and D, owned a farm worth \$4,400. C owned $\frac{5}{6}$ as much as D; D bought 25% of C's; how much did each then own?

13. A man, after selling $\frac{1}{3}$ of his sheep, found that 75 was $\frac{5}{12}$ of the remainder. Had he sold 120, what per cent would he have had left?

14. What per cent of \$18 is \$24?

15. A room is 18 ft. by 24 ft. by 9 ft. There are 2 doors, 4 ft. by $7\frac{1}{2}$ ft., 2 windows, 4 ft. by 6 ft., and a fireplace 5 ft. square. There is also a base-board running around the room 12 in. wide. Find the number of square feet of plastering in the room.

16. In what time will \$360 gain \$48.87 at 3%?

17. \$28.50 was deducted from the list-price of an article. If the discount was $37\frac{1}{2}$%, what was the list-price?

REVIEW OF PERCENTAGE.

1. What per cent of 12 bu. is 6 pk.?

2. A horse was sold for $225 at a gain of 12½%. What did it cost?

3. Two boys have 567 apples. One has 33⅓% more than the other. How many has each?

4. What fraction increased by 20% of itself equals ⅔?

5. One farmer has 306 sheep; this is 66% less than B has. How many have both?

6. If I lose 13% by selling an article for 52 cents less than cost, how should it be sold to gain 12%?

7. I gained 23% by selling 24 bbl. of apples for $8.28 more than cost. What was the cost a barrel?

8. A commission merchant charged $17.28 for selling 320 bu. of potatoes at 60¢ a bushel. What was the rate of his commission?

9. Find the premium paid for insuring buildings for $3,500 at 1¾%, and furniture worth $3,000 at ¾%.

10. If I pay $468 to insure property worth $10,400, what is the rate?

11. The valuation of a town is $175,600. There are 276 polls, each assessed $1. The town wishes to raise $2,910. What tax will a man pay who owns a house valued at $3,000?

12. What is the interest on $1,785 from Aug. 16, 1898, to Mar. 28, 1901, at 7%?

13. A and B received $3,159 as the interest on their money invested for 6 yr. 6 mo. at 6%. If B's money equals ⅘ of A's, how much money has each?

14. A farmer had a field 24 yd. long and 18 yd. wide, in which he planted potatoes. The rows ran lengthwise, and were two feet apart, and two feet from the fence. The hills were 18 in. apart, and 18 inches from the fence. How many hills did he plant?

ORAL.

1. What number is that to which if its half be added the sum will be 30?

2. What number is that to which if its third be added the sum will be 24?

3. There is a pole $\frac{1}{2}$ and $\frac{1}{3}$ under water, and 4 ft. out of water. How long is the pole?

4. A man who has failed in trade is able to pay only 62¢ on the dollar. If he owes your father $100, how much will your father lose?

5. If 3 men spend $12 in a week, how many dollars will 4 men spend in 5 weeks at the same rate?

6. Two men are 60 miles apart, and traveling in the same direction. If one travels 28 miles a day and the other 34 miles a day, in how many days will they be together?

7. If three men can do a piece of work in $9\frac{3}{7}$ days, how long will it take 7 men to do it?

8. If 9 apples cost 18 cents, what will 3 apples cost?

9. If three oranges cost 18 cents, what will 6 oranges cost?

10. Three times five and $\frac{3}{5}$ of 5 are how many times 6?

11. Four times 7 and $\frac{2}{7}$ of 7 are how many times 6?

12. $5\frac{3}{7}$ is $\frac{1}{3}$ of what number?

13. $8\frac{5}{8}$ is $\frac{1}{5}$ of what number?

14. $2\frac{4}{5}$ is $\frac{1}{7}$ of what number?

15. $4\frac{2}{3}$ is $\frac{1}{4}$ of what number?

16. At 20¢ a dozen, what will 18 eggs cost? 30 eggs?

17. At 8¢ a pound, what will 3 lb. 8 oz. of sugar cost? 4 lb. 2 oz.? 2 lb. 4 oz.?

18. A bushel of oats weighs 32 lb. How many bushels are there in 160 lb?

19. What is the outer length of a sidewalk 1 yard wide, which extends around a garden 30 yards long and 20 yd. wide?

20. If 8% of my money is $24, how much money have I?

1. What is the compound interest of $8,050 for 3 yr. 6 mo. at 8%?

2. Sold a bill of goods for $450, but gave a discount of 8% for cash. What was the discount?

3. How many board feet can be cut from a stick of timber 60 ft. long, 18 in. wide, and 15 in. thick, if no allowance is made for waste in cutting?

4. How many cubic inches in a globe 36 in. in diameter?

5. Find the cost of the following bill of lumber at $18 a thousand:

200 boards, 16 ft. by 10 in.

150 boards, 12 ft. by 12 in.

40 planks, 12 ft. by 10 in. by 3 in.

20 scantling, 15 ft. by 4 in. by 2 in.

6. Find the cost of the cellar-wall of a house at $1.75 a perch, if the house measures 60 ft. by 45 ft., and the wall is 8 ft. high by $1\frac{1}{2}$ feet thick.

7. How many bushels of potatoes can be put in a wagon-box 18 ft. long, 3 ft. wide, and 2 ft. deep?

8. Find the cost of $57\frac{1}{2}$ yd. of cloth $\frac{3}{4}$ yd. wide, if $39\frac{1}{2}$ yd. of the same cloth $\frac{3}{5}$ wide cost $118.50.

9. Express $\frac{1}{8}$ of $\frac{3}{5}$ decimally.

10. Add 215 units, 215 tenths, 215 hundredths, 215 thousandths.

11. Find the prime factors common to 21, 52, and 95.

12. Find the volume of a pyramid the area of whose base is 30 sq. ft., and whose altitude is 18 ft.

13. In the center of a circular field 30 rd. in diameter is a circular pond 10 rd. in diameter. How many square rods of the field are not covered by water?

14. Find the area of a regular octagon whose side is 32 ft., and apothem 38 ft.

15. In what time will $700 at 6% amount to $763?

1. Find the compound interest on $483.96 for 2 yr. 5 mo. 15 da. at 6% annually, if interest is compounded semi-annually.

2. Find the volume of a cone whose altitude is 16 in. and radius of the base 4½ inches.

3. Make out a receipted bill for the following items:

May 1, 1898, Mr. J. R. Jones bought of Smith Bros. 14 yd. of silk @ $1.75; May 10, 58 yd. cotton cloth @ 9¢; May 12, 10 yd. broadcloth @ $2.25; May 18, 24 yd. carpet @ 87½¢; June 3, 40 yd. matting @ 35¢; June 7, 5 sets curtains @ $3.75.

4. Thomas has a number of cents; Frederick has three times as many. Charles has as many as Thomas and Frederick together, and Henry has three-fourths as many as the other three. If all together they have $5.04, how many has each?

5. What is a prime number? Write one.

6. Name and define all the terms used in Subtraction; in Multiplication; in Division.

7. Define Antecedent; Consequent; Ratio; Proportion.

8. Define Compound Interest; a fraction.

9. Change $\frac{5}{8}$ of a square mile to integers of lower denominations.

10. Find the interest on $284.60 at 7% from June 12, 1899, to Sept. 5, 1902.

11. The height of a cone is 20 in., and the radius of its base 15 in. Find its volume.

12. In what time will $425.75 gain $8.51½ at 6%?

13. What principal will gain $105.00 in 4 yr. 8 mo. at 6%?

14. Using your table, find the compound interest of $3,000 for 9 yr. 6 mo. 18 da. at 4%.

15. The gain on the sale of a lot of goods was $300, which was 8⅓% of their cost. Find the cost.

16. A and B can do a piece of work in 18 days. A alone can do it in 24 days. In how many days can B alone do it?

17. The antecedent is 37½; the consequent, 150; find the ratio.

1. What is $3\frac{1}{2}\%$ of 8,724 bu.?

2. What is 30% of 12 rd. 2 ft. 8 in.?

3. What per cent of 12 rd. is 2 yd. 2 ft. 3 in.?

4. What per cent of $2\frac{1}{2}$ A. is 40 sq. rd.?

5. What per cent of \$12 is \$600?

6. \$4,620 is 131% more than what?

7. What is the rate per cent of gain on an article bought for \$465 and sold for \$620?

8. Selling-price \$19,700; cost, \$20,000. Find the rate per cent of loss.

9. The net proceeds of a sale were \$2,825.55. What rate per cent did the agent charge if he sold 3,150 bu. of wheat at 92¢ a bushel?

10. The taxable property of a town is \$329,864, and the tax to be raised is \$4,123.30. If your father owns property to the value of \$1,126, what tax must he pay?

11. The tax collector of a town received \$392.00 for collecting taxes. If the rate of his commission was $1\frac{3}{4}\%$, how much money did he collect?

12. Find the amount of \$278.64 at $6\frac{1}{2}\%$ from Dec. 3, 1898, to May 1, 1901.

13. How many square inches of tin will be required to make a box 9 in. long, $3\frac{3}{4}$ in. wide, and $3\frac{1}{2}$ in. deep?

14. To how much will \$928 amount in 5 yr. 7 mo. 18 da. at 7 per cent?

15. If $1\frac{1}{3}$ A. of land cost \$76, what will $1\frac{3}{9}$ of an acre cost?

16. If a man owns $\frac{5}{11}$ of a mill, and sells $\frac{5}{7}$ of his share for \$10,000, what is the value of the entire mill?

17. A man sold two horses at \$80 each. On one he gained 20%, and on the other he lost 20%. Did he gain or lose? How much?

18. Find the area of a regular hexagon whose side is 11 ft. and apothem 9.5 ft.

1. I sold two horses for $390, and made 20% on one, and lost 25% on the other. Find the cost of each.

2. A man bought 118 bbl. of apples, and sold them for $345, gaining 15%. If the apples had been sold for $275, what would have been the loss per cent? What did the apples cost a barrel?

3. Find the entire surface of a cone whose slant height is 19 in. and the diameter of whose base is 8 in.

4. What are the solid contents of a cylinder whose diameter is 16 in. and whose length is 12 ft.?

5. A field is in the form of a trapezium. The longest diagonal is 70 rd., and the perpendicular distances from the opposite corners are 20 rd. and 30 rd. respectively. How many acres in the field?

6. The difference between two numbers is 40, and the larger is 5 times the smaller. What are the numbers?

7. A farmer has three flocks of sheep, numbering in all 320 sheep. The flocks are in relative size as the numbers 1, 2, and 5. How many sheep are there in each flock?

8. A had $5,000 in the bank. He drew out 20% of it, then 30% of the remainder, and afterwards deposited 15% of the sum he had drawn out. How much money did he then have in the bank?

9. How much must be paid for the use of $3,000 from Jan. 4, 1897, to Aug. 25, 1901, the rate being $7\frac{1}{2}$%?

10. I loaned my friend $900. At the end of 3 yr. 4 mo. 27 da. he paid me $1,145.40. What rate of interest did he pay?

11. A farmer lost $840 by selling his farm for 16% less than it cost. How much did it cost?

12. A man has a yearly income of $4,200. If he spends $16\frac{2}{3}$% of it the first year, $14\frac{2}{7}$% the second, and $28\frac{4}{7}$% the third, how much will he save in three years?

1. What is the cash value of a bill of goods amounting to $2,250 at a discount of 20% and 5% for cash?

2. How much will a discount of 25% and 5% reduce a bill of $2,400?

3. Which is better for the purchaser, and how much, a discount of 20% and 10%, or a discount of 30%, from a bill of $3,675.75?

4. The difference between the ages of a father and his son is 24 years, and the father's age is three times that of the son. What is the age of each?

5. A man drew out 34½% of his deposit in the bank. Of that sum he spent 9½%. If he spent $78.66, how much had he in the bank at first?

6. A high-school building is insured for $27,000, which is ¾ of its value. If it cost $594 premium, at what rate was it insured? and what was its value?

7. A merchant bought 360 yd. of cloth for $630. ¼ of it was damaged by fire, but he sold the remainder so as to gain 20% on the whole. Find the selling-price of a yard.

8. The premium on 4,800 yd. of silk was $175. The insurance was on ⅚ of the value of the silk at 3½%.

9. Find the amount of $748.50 from Jan. 5, 1898, to Aug. 5, 1899, at 4%.

10. A grocer insured his goods for $18,000, which was ⅞ of their value, paying a premium of $225.

11. A speculator insured 25,000 bu. of wheat for ⅝ of its value at 1⅛%, and paid a premium of $225.

12. A drover sold 600 sheep at $5 a head, and gained 50% on one-half of them, and lost the same per cent on the other half. Find the net gain or loss.

13. A man bought a farm of 350 acres. 15% of it cost $28 an acre, 25% cost $35, 18% cost $37, and the remainder, $40. What did his farm cost?

1. What is the area of a circle if the distance around it is 8 rd.?

2. At $175 an acre, what is the value of a triangular piece of land one of whose sides is 64 rd., and the perpendicular distance from the opposite vertex to that side 32 rd.?

3. How many cubic inches are there in a square pyramid the perimeter of whose base is 4 ft. 9 in., and whose altitude is 2 ft. 9 in.?

4. The parallel sides of a trapezoid are 24 rd. and 68 rd., and the distance between them 24 rd. Find the area in acres.

5. How many square feet are there in the surface of a sphere whose diameter is 17 in.?

6. $460.62½ is the interest of what sum at 5½% for 2 yr. 9 mo. 15 da.?

7. What is the duty, at 18% *ad valorem*, on 450 boxes of raisins, each box containing 32 lb., invoiced at 9¢ a pound?

8. A man who owned ⅗ of a mill sold 33⅓% of his share for $8,680, and gained 8½%. Find the cost of the mill.

9. At the end of 3 yr. 7 mo. 28 da. a man found that a certain sum of money put on interest at 7% had amounted to $2,261.30. Find the sum.

10. An employer received from his agent $1,185 as the net proceeds of a sale of $1,250.

11. A house valued at $7,200, and insured for ¾ of its value at $12.50 a $1,000, was destroyed by fire. What was the owner's loss?

12. What is the rate of taxation when $23,803.60 must be raised on a total valuation of $2,975,450?

13. Find the compound interest of $800 for 3 yr. 7 mo. 18 da. at 6%, interest compounded annually.

14. A man spent ⅓ of his money for a horse, and ⅔ of it for three bicycles, and had $224 left. How much did the horse and each bicycle cost?

MEASUREMENTS.

1. What will it cost to paper a room $24' \times 20' \times 10'$ with paper costing 20¢ a roll? There are two windows and one door, averaging 20 square feet each.

2. A room 32 ft. square is 8 ft. high. At 60¢ a single roll for paper 30 in. wide, what will it cost to paper the walls and ceiling? There are two doors, $4\frac{1}{2}' \times 7'$; 3 windows, $4' \times 6'$.

3. Mr. Jones has a city lot measuring 66 ft. by 132 ft. What is it worth at $2,000 an acre?

4. Find the area of a field bounded as follows: from A the line runs east 24 rd. to B, thence forming a right angle at B south, 10 rd. to C; thence 6 rd. in a straight line towards A to D, thence forming a right angle at D southwest 4 rd. to E, thence in a line parallel with CD prolonged $8\frac{1}{2}$ rd. to F; thence 12 rd. to point of beginning.

NOTE. — CD prolonged to A is 20 rd.

5. The boundary of Mr. B's farm is as follows: from A east 104 rd. to B; thence south 48 rd. to C; thence 32 rd. toward A to D; thence south 40 rd. to E; thence toward A 48 rd. to F; thence forming a right angle southwest to G, 40 rd.; thence to A. Find area of farm.

NOTE. — Prolong CD to A, prolong EF to A, 57 rd.; prolong GF till it intersects AD at H, 21 rd. Draw EH, 53 rd. From D drop a perpendicular to EH, 15 rd.

6. How many board feet in 66 boards, each board 7 ft. long and 10 in. wide?

7. How many board feet in 100 boards, each 9 ft. long and 8 in. wide?

8. How many shingles laid 4 in. to the weather will cover a roof 40 ft. long and 18 ft. wide?

9. A field in the form of a trapezoid is 85 ft. wide, and its two parallel sides are 120 ft. and 100 ft. respectively. Find its area.

1. How many bushels of wheat in a bin $12' \times 4' \times 6'$, if full?

2. A filter is 14 ft. in diameter and 10 ft. deep. On the bottom is a layer of charcoal 4 ft. deep. How many gallons of water in the filter if the water is within 2 ft. of the top?

3. A house-lot has a frontage of 55 ft. and a depth of 130 ft. I wish to raise the front 4 ft., and slope evenly to the back. What will it cost at $1.50 a load?

4. What is the volume of a smoke-stack 4 ft. in diameter and 65 ft. in height?

5. How many cubic feet in an attic storeroom 40 ft. wide, 60 ft. long, and 10 ft. from the floor to the ridgepole?

6. In using our solar lantern the rays of light from the lens to the curtain form a cone of light. If the curtain is 20 ft. from the lens, and the diameter of the circle on the curtain is 12 ft., how many cubic feet of air are in the cone of light?

7. A furniture dealer sold a parlor-set for $70, and gained $16\frac{2}{3}\%$ by so doing. What per cent would he have gained had he sold it for $72?

8. What per cent would a farmer gain by selling a cow for $56, if by selling her for $60 he gains 50%?

9. A bookseller sold a set of encyclopedias for $26, at a profit of $8\frac{1}{3}\%$. What per cent would he have made by selling the set for $28?

10. In a school of 168 pupils, twice as many study history as Latin, and twice as many study algebra as history. How many pupils are there in each class?

11. A father's age is three times that of his son, and their ages added together amount to 48 years. How old is the son?

12. A commission merchant charged $103.68 for selling 960 bbl. of potatoes at $2.40 a barrel. Find his rate of commission.

13. If $118.44 is the premium, and 70¢ on a $100 the rate, what is the amount of insurance?

1. A man sold a span of horses for $660, and gained 10% by so doing. What would have been the gain or loss per cent if the horses had been sold for $570?

2. Mr. B. sold his bicycle for $82, and gained 23%. What per cent would he have gained or lost had he sold it for $64?

3. Find the gain per cent on an article sold for $107.80, if there is a gain of $14\frac{2}{7}$% when sold for $112?

4. What will be the rate of the tax if $98,640 is raised on real estate valued at $9,864,000?

5. For how long did I lend a man $111 if he paid me $2.22 interest at 8%?

6. What principal will earn $54 interest in 1 yr. 6 mo. at 4%?

7. A B and C can do a piece of work in 5 days; A and C can do it in $6\frac{1}{2}$ days. In what time can B do $\frac{2}{3}$ of it?

8. If $5\frac{1}{8}$ yd. of cloth cost $\$4\frac{5}{16}$, what will $17\frac{3}{8}$ yd. cost?

9. What is gained on 6,120 buttons bought at $8.50 a great gross, and retailed at 12¢ a dozen?

10. What will be the cost of 3 bu. 2 pk. 4 qt. 1 pt. of nuts at $1.75 a bushel?

11. A floor 26 ft. long contains 325 sq. ft. Find the width of the floor.

12. The area of the gable end of a house is 46 sq. yd. If the house is 42 ft. wide, find the height of the ridge.

13. Find the cost of carpeting a room 32 ft. by 25 ft. with Brussels carpeting at $\$1.37\frac{1}{2}$ a yard, if the strips run lengthwise, and 8 in. on a breadth is allowed for matching.

14. I have two rooms, one 15 ft. square, the other $14\frac{1}{2}$ ft. $\times 16$ ft., each $8\frac{1}{2}$ ft. high. What will it cost to paper the walls and ceilings of both rooms with paper costing 36¢ a roll, deducting 20 sq. ft. for each of 7 doors and windows, and allowing 13¢ a yard for border?

15. A dealer sold 120 bbl. of flour for $792, which was 12% less than he paid for it.

ORAL.

1. In 840 in. how many feet?

2. At 2¢ a foot, find the cost of a rope 720 in. in length.

3. At 1¢ an inch, find the cost of three pieces of ribbon. In one piece there are 27 in., in another ¼ yd., and in the third 1½ yards.

4. If you earn $25, and then spend $17.25 for a suit of clothes, $3.25 for a pair of shoes, how much of your money will you have left?

5. If two desks are worth $1½, what are two dozen desks worth?

6. At 40¢ a peck, what will a farmer receive for 96 qt. of beans?

7. Find the cost of 4½ lb. of beefsteak at 16¢ a pound, and four chickens at $1¼ each.

8. If a box of butter contains 25 lb., what will 4 boxes cost at 25¢ a pound?

9. Find the cost of an ounce of tea when ½ lb. costs $.32.

10. If a man's salary for 8 months is $840, what will be his salary for 6 months?

11. $250 \div \frac{2}{5}$ of $25 = ?$

12. How many times can you sell a quart of chestnuts if you sell 3 bu.?

13. The divisor is 9, the quotient 16. What is the dividend?

14. If I have $3.50 at first, how many peanuts can I buy at 5¢ a quart and have 30 cents left?

15. Find the cost of 4½ gal. oil at 8¢ a gallon.

16. Find the cost of 1 lb. of candy if 2 oz. cost 12¢.

17. What is the seventh part of 574?

18. If 2 bu. of apples cost $2.40, what will a peck cost?

19. How many sevens must be added together to make 224?

20. $18 pays for how much insurance at ¾% premium?

1. I asked \$184 for my horse. This was a gain of 15%. I sold him for \$150. What per cent did I lose?

2. A speculator sold two farms for \$4,000 each. On the one he gained 20%, and on the other he lost 20%. Did he gain or lose? and how much?

3. An agent sold goods to the value of \$13,656, and received as his commission \$307.26. What was the rate of commission?

4. What tax must I pay if my property is valued at \$5,600 in a town where a tax of \$3,240 is to be raised? There are 398 polls, each paying \$1.50, and the taxable property is valued at \$440,500.

5. A house worth \$16,000 was insured for $\frac{7}{8}$ of its value at $1\frac{1}{2}$%. If it was totally destroyed by fire, find the loss to the owner and to the company.

6. Find the interest on \$1,248 from Mar. 4, 1896, to Aug. 12, 1899, at 7%.

7. Find the interest on \$3,020 from Apr. 14, 1897, to June 10, 1900, at $5\frac{1}{2}$%.

8. What principal at interest at 5% will gain \$97 in 2 yr. 8 mo. 12 da.?

9. At what rate will \$480 gain \$88.00 in 3 yr. 8 mo.?

10. In what time will \$1,440 at 5% give \$234.60 interest?

11. Find the compound interest on \$2,000 for 4 yr. 6 mo. at 7%.

12. Find the compound interest on \$620 for 4 yr. 3 mo. at 6% annually, interest payable quarterly.

13. Find the difference between the simple and compound interest of \$660 for 3 yr. 4 mo. 24 da. at 6%.

14. What reduction from the price of an article is 5%, 10%, and 25% off?

15. A merchant marks goods at 20% above cost, and sells at $12\frac{1}{2}$% below the marked price. What per cent does he gain? How much does he gain on goods costing \$1,200?

1. What is the duty, at 22¢ a gallon, on 600 qt.-bottles of oil, breakage 5%?

2. A merchant imported 600 yd. of dress goods, invoiced at 8 francs a yard. What is the duty at 40% *ad valorem?*

3. What is the duty at 18¢ a sq. yd., and 30% *ad valorem*, on 1,000 yd. of carpet $\frac{3}{4}$ yard wide, invoiced at 10 francs a yard?

4. If a man travel 720 miles in 30 days of 7 hr. each, how far will he travel in 7 days of 10 hr. each?

5. Brooks raised five times as many bushels of potatoes as Avery, and Maxfield 10 bushels more than both of the others. If all together they raised 328 bushels, how many did each raise?

6. Find the entire surface of a cylinder whose altitude is 8 ft. and the radius of the base 4 ft. Find contents.

7. The slant height of a cone is 50 ft., and the diameter of the base 18 ft. Find its convex surface.

8. A room measures $18' \times 12' \times 10'$. At 37¢ a square yard, find the cost of plastering it, allowing 80 sq. ft. for doors and windows. At \$1.12$\frac{1}{2}$ a yard, find the cost of Brussels carpet laid lengthwise, allowing 8 in. loss on each breadth for matching.

9. What is the cost of 10 girders each 40 ft. long, 14 in. wide, and 12 in. thick, at \$28 per M.?

10. A barn is 80 ft. long, 50 ft. wide, with 20-ft. posts. The roof has a $\frac{1}{3}$ pitch, and the rafters are 28 ft. long. How many boards 16 ft. long and 15 in. wide will it take to roof and board it?

11. An irregular stone was thrown into a cylinder 3 ft. 4 in. in diameter, which was partly filled with water. After the stone was thrown in, the water in the cylinder rose 10 in. Find the contents of the stone.

12. A bin is 11 ft. 6 in. long, 4 ft. wide, 6 ft. 3 in. deep. How many bushels of wheat will it hold? How many of apples?

COMPOUND PROPORTION.

1. If 4 men in 24 days of 9 hours each build a wall 40 ft. long, 9 ft. high, and 4 ft. thick, in how many days of 6 hours each can 8 men build a wall 60 ft. long, 12 ft. high, and 5 ft. thick?

(*a*) If 4 men in 24 days can build a wall, in how many days can 8 men build it? See GRADE VI., Lesson 84.

8 men : 4 men. = 24 da. : x da. = 12 da.

(*b*) If in 12 days of 9 hours each some men can build a wall, in how many days of 6 hours each can they build it?

6 hr. : 9 hr. = 12 da. : x da. = 18 da.

(*c*) If in 18 days some men can build a wall 40 ft. long, in how many days can they build a wall 60 ft. long?

40 ft. : 60 ft. = 18 da. : x da. = 27 days.

(*d*) If in 27 days some men can build a wall 9 ft. high, in how many days can they build one 12 ft. high?

9 ft. : 12 ft. = 27 da. : x da. = 36 days.

(*e*) If in 36 days some men can build a wall 4 ft. thick, in how many days can they build one 5 ft. thick?

4 ft. : 5 ft. = 36 da. : x da. = 45 days.

2. How many examples in Simple Proportion have we formed from this example?

3. These five examples can be united like this:

$$\left.\begin{array}{rl} 8 \text{ men} & : 4 \text{ men} \\ 6 \text{ hr.} & : 9 \text{ hr.} \\ 40 \text{ ft.} & : 60 \text{ ft.} \\ 9 \text{ ft.} & : 12 \text{ ft.} \\ 4 \text{ ft.} & : 5 \text{ ft.} \end{array}\right\} = 24 \text{ da.} : x \text{ da.}$$

NOTE. — Since the product of the means is to be divided by the product of the extremes, we can arrange for cancellation thus (the means above the line, and the extremes below):

$$\frac{4 \times 9 \times 60 \times 12 \times 5 \times 24}{8 \times 6 \times 40 \times 9 \times 4} = 45 \text{ by cancellation.}$$

NOTE. — Observe that every example in Compound Proportion can be divided into as many examples as there are ratios, and that these can be worked separately or together. The second method is the shorter. The first method should be used till the pupils understand the work.

COMPOUND PROPORTION.

1. If $100 gain $6 in 12 months, how long will it take $400 to gain $18?

2. If 12 men make 264 pairs of boots in 4½ weeks, working 6 days a week, and 9 hr. a day, how many pairs will 36 men make in 13½ weeks, working 4¼ days a week, and 8 hours a day?

3. If 6 men can dig a ditch 20 rd. long, 12 ft. deep, and 4 ft. wide in 16 days, working 9 hours a day, how many days will it take 24 men to dig a ditch 200 rd. long, 16 ft. deep, and 6 ft. wide, working 8 hours a day?

4. If 6 men build a wall 15 yd. long, 4 yd. broad, and 5 ft. high, in 3 days of 12 hours, in how many days of 8 hours will 8 men build a wall 20 yd. long, 8 yd. broad, and 8 ft. high?

5. If 15 men, working 6 hours a day, can dig a cellar 80 ft. long, 60 ft. wide, and 10 ft. deep, in 25 days, how many days will it take 25 men, working 8 hours a day, to dig a cellar 120 ft. long, 70 ft. wide, and 8 ft. deep?

6. If 16 men dig a ditch 40 rd. long, 3 ft. wide, 2 ft. deep, in 10 days of 12 hours, in how many days of 10 hours can a ditch 60 rd. long, 3½ ft. wide, 3 ft. deep, be dug by 20 men?

7. If 6 men, in 3 days of 12 hours, plow a field 80 rd. long and 40 rd. wide, how long will it take 3 men, working 10 hours a day, to plow a field 60 rd. long and 30 rd. wide?

8. If 4 horses eat 3 bu. of oats in 2 days, how much will 6 horses eat in 12 days?

9. If a 10-cent loaf of bread weighs 15 ounces when flour is $8 a barrel, how much will a 5-cent loaf weigh when flour is $6 a barrel?

10. If 32 men can lay 600 rd. of railroad-track in 15 days, in what time can 40 men lay 840 rd. of track?

11. If a man charges $48 for 16 days' work of 8 hr. each, what should he charge for 12 days' work of 10 hr. each?

ALGEBRA.

1. The greater of two numbers is twice the less, and the sum of the numbers is 135. What are the numbers?

2. The sum of the ages of a mother and daughter is 36 years, and the age of the mother is eight times that of the daughter. What is the age of each?

3. A man traveled 320 miles in three days. If he traveled three times as far the first day as he did the third, and four times as far the second day as the third, how far did he go each day?

4. Divide 36 into three parts so that the first part shall be 3 times the second, and the second two times the third.

5. A farmer bought a horse, a cow, and a calf for $104. The cow cost three times as much as the calf, and the horse three times as much as the cow. What was the cost of each?

6. The expressions $6 + 4 = 10$, or $6a + 4a = 10a$ are called equations. The parts at the left and right of the sign $=$ are called members, or sides. They are distinguished as first member, or left side, and second member, or right side.

7. The product of 4 and 3 is written 4×3, but the product of a and b is not written $a \times b$, but ab. The product of 5, x and y is written $5xy$.

8. Write the product of 8 and c; 4, a, and d; 7, x, y, and z.

9. In the expression $5xy$, 5, x, and y are the factors of $5xy$. When one of the factors of an expression is a numerical quantity, it is called the coefficient of the remaining factors.

10. The index has the same meaning as in arithmetic. $3a$ and a^3 are not alike. $3a$ means $a + a + a$. a^3 means $a \times a \times a$. If $a = 4$, find the value of $3a$ and of a^3. *Be careful to distinguish between coefficient and index.*

11. Express in the form of a fraction $15 \div 5$. In the same way express $3x \div 2$; $4x \div 5$; $a \div b$; $2 \div c$.

ALGEBRA.

1. If $a = 4$, $b = 3$, $c = 1$, $x = 2$, $y = 5$, $z = 6$, find the value of:

$4a$, $3c$, $4y^3$, a^2, $2b^4$, $5x^3$,
$7z$, c^2, $3z^3$, z^3, $4y^4$, $7x$,
$2ab$, $3bc$, $4cx$, $5xy$, $6yz$, $2a^2x^3$.

2. If $a = 4$, $b = 1$, $c = 3$, $x = 5$, $y = 7$, $z = 0$, find the value of:

$3x + 5z - 7b$; $3y - 4z + 7c$; $3a - 5b + c$.
$5c - 8z + 3a$; $4x - 2y - 3b$; $2x - 3y + 5a$.
$x^2 - 3a^2 + 2c^3$; $b^3 - 2z^2 + 3a^2$; $xz - zb - 2cz$.

3. Express four increased by five; a increased by b.

4. Express 9 diminished by 5; a diminished by b.

5. If the dividend is 12, and the quotient 4, express the divisor.

6. How much does b lack of being 15?

7. If a man walks 3 miles an hour, how many miles will he walk in x hours?

8. If a man walks x miles an hour, how many miles will he walk in c hours?

9. If a man walks z miles an hour, how many hours will it take him to walk a miles?

10. If one part of 12 is 7, what is the other part?

11. If one part of 15 is x, what is the other part?

12. If one factor of 25 is 5, what is the other factor?

13. If one factor of 18 is x, what is the other factor?

14. If a pear costs $2x$ cents, and a peach $3x$ cents, what will represent the cost of both?

15. What will 8 yards of cloth cost at $2x$ cents a yard?

16. Draw a rectangle. Call the length x in. and the width y in. Express the perimeter of the rectangle. Express one-half of the perimeter. Express the difference between the length and the breadth.

ALGEBRA.

1. Express the area of the rectangle; $\frac{1}{2}$ of the area.

2. Express the square of x; the cube of y; the fourth power of a.

3. If x and y represent two numbers of which x is the greater, what will represent their sum? their difference? their product? their quotient?

4. In the equation $6 + 4 = 10$, add 2 to the first side. What must you do to the other side to preserve the equation?

5. Learn: If anything is added to one side of an equation, an equal amount must be added to the other side.

NOTE. — A self-evident statement like the above is called an Axiom.

6. If $3x = 9$, what does $3x + 5$ equal?

7. If $x - 4 = 8$, what does x equal?

8. If $x = 2$, how can you change the equation so that the right side shall be 6?

NOTE. — The last three examples are illustrations of Axiom 1. Prove it.

9. In the equation $6 + 4 = 10$, subtract 4 from the left side. What must you do to the other side to preserve the equation?

AXIOM 2. — If anything is subtracted from one side of an equation, an equal amount must be subtracted from the other.

10. If $x = 7$, what will $x - 3$ equal?

11. If $x + 4 = 6$, what does x equal?

12. If $x = 9$, how can you change the equation so that the right side shall be 5?

13. In the equation $6 = 6$, multiply the left side by 3. What must you do to the right side to preserve the equation?

14. Write the statement as Axiom 3.

15. If $x = 4$, what will $7x$ equal?

16. If $\frac{4x}{5} = 20$, what does $4x$ equal?

ALGEBRA.

1. In the equation $6 = 6$, divide the left side by 2. What must you do to the right side to preserve the equation?

2. Write the statement as Axiom 4.

3. If $4x = 12$, what does x equal?

Express in the form of equations the following statements:

4. a is equal to b added to c.

5. 25 exceeds 19 by 6.

6. The excess of 17 over 8 is 9.

7. The excess of x over y is z.

8. Write three times the expression three plus four.

9. Write two times the expression x minus y.

10. What number is less than 16 by 4?

11. What number is less than 12 by y?

12. Write the next integral number above x.

13. Find two numbers whose sum is 180, and whose difference is 40.

14. Divide the number 133 into two parts such that one part is 15 more than the other.

15. Three men together have $68,400. If the second has $3,000 more than the first, and the third $2,400 more than the second, how much has each?

16. If to three times a number I add 38, I shall obtain 98. What is the number?

17. A man and his two sons sawed 25 cd. of wood. The elder son sawed 5 cd. less than three times as many as the younger son, and the father sawed twice as many as the elder son. How many cords did each saw?

18. A man sold three houses of equal value, and a barn for $24,400. If the barn brought $1,600 less than a house, what was the price of each?

19. One number is 4 times another, and their difference is 30. Find the numbers.

ALGEBRA.

1. A triangle has a base a feet long and an altitude $2b$ feet long. What is its area?

2. A boy had a kite-string x yards long. From it he cut three pieces each y feet long. How many feet did he have left?

3. At $\$x$ each, how many barrels of flour will y bushels of apples buy at $\$a$ a bushel?

4. The diameter of a circle is $2a$ feet, and its circumference $2b$ feet. What is its area?

5. Let c represent the circumference of a cylinder and a its altitude. Find its convex surface.

Copy, and fill blanks:

6. If the same or equal quantities be added to or subtracted from —— members of an ——, the —— is not destroyed.

7. If both members of an —— be ——, or —— by the same or equal quantities, the equality is not destroyed.

Solve the following equations:

8. $3x + 4 = x + 12$. $3x + 5 = x + 9$.

9. $5x - 5 = 16 - 2x$. $2x + 5 = 17 - x$.

10. John is two times as old as Henry, and the sum of their ages is 18 years. What is the age of each?

11. Alice had some money, and earned twice as much. After spending 9 cents, she had 21 cents left. How much money did she earn?

12. The sum of two numbers is 155, and the greater is 4 times the less. What are the numbers?

13. The difference of two numbers is 132, and the greater is 4 times the less. What are the numbers?

14. Samuel has a certain number of marbles, and John has 15 more than Samuel. If together they have 103 marbles, how many has each?

15. The sum of two numbers is 58, and the greater is 7 less than 4 times the smaller. What are the numbers?

GEOMETRY.

1. Place a cube on your desk. How many dimensions has it? How many faces has it?

2. These faces are called its surfaces. A surface is a boundary of a solid. Define surface.

3. How many dimensions has each surface?

4. Surfaces are bounded by edges called lines. A line is the limit of a surface, or it is the path traced by a point as it moves from one position to another. To read a line we usually use two letters, naming the starting-point first.

5. How many dimensions has a line?

6. How are the lines of the cube limited?

7. A point is the limit of a line and has no extent, only position. Define point.

8. In the cube how many faces meet to form a line?

9. Each face is bounded by how many lines? If the cube has six faces, and each face has four lines, how many lines has the cube? Why is not the number 24?

10. How many lines meet at each point? If the cube has 12 lines, and each line has two points, how many points has the cube? Why not twenty-four?

11. In a square prism, how many surfaces, lines, and points are there?

12. By how many lines is each surface bounded? How many surfaces meet in each line? How many lines meet at each point? Are the surfaces the same shape? The same size?

13. Examine in the same way a triangular prism and an hexagonal prism.

14. What kind of lines have you found on these solids?

15. A straight line is a line which has the same direction throughout its entire length. Define a straight line. Draw one.

16. Look at a cylinder. How many edges or lines has it? Are these lines straight? What are they?

GEOMETRY.

1. Define a curved line. Write: A curved line is a line that constantly changes its direction.

2. Fasten a weight to one end of a cord. Hold the other end at rest in the hand. This is a plumb line, and is said to be vertical.

3. Define a vertical line. Draw one.

4. A horizontal line is a line which has the direction of any line in the surface of still water. Practically it is a line that points towards the horizon.

5. Lines neither vertical nor horizontal are called inclined lines or oblique lines.

6. Make three points not in the same line. Join them by straight lines. How many straight lines can be drawn?

7. How are horizontal lines represented on paper? Vertical lines?

8. Hold your ruler vertically, horizontally, inclined. Draw on paper lines to represent these three positions.

9. Draw a vertical line, and through it two horizontal lines.

10. Draw two lines which have the same direction, that is, do not meet, however far extended. These lines are said to be parallel. Define parallel lines.

11. Draw two parallel straight lines. Two parallel curved lines.

12. Draw two parallel horizontal lines. Two parallel vertical lines.

13. Draw two lines not parallel. Prolong them till they meet.

14. This point of meeting is called their intersection. Define intersection.

15. Draw a line and name it AB. Take a point outside of this line and name it C. How many parallels to AB can be drawn through C.

GEOMETRY.

1. Hold two pencils parallel. Hold them so they would intersect.

2. Hold two rulers parallel; not parallel.

3. Are two vertical lines always parallel to each other?

4. Can two horizontal lines ever intersect each other?

5. By means of a triangle and a ruler draw through a point outside of a given line, a parallel to that line.

6. Draw several parallel lines free-hand. Test and correct them with ruler and triangle.

7. Write: When one line meets another line so as to make the adjacent angles equal, the lines are said to be perpendicular to each other.

8. Draw two lines so as to form equal adjacent angles. Define perpendicular lines.

9. Draw a line perpendicular to a vertical line. Draw one perpendicular to an inclined line.

10. Draw three lines: *a*) All parallel; *b*) Two parallel, one perpendicular to them; *c*) No two parallel, all intersecting at one point; *d*) No two parallel, and not all meeting in a point.

11. In case *d*), in how many points do the lines intersect?

12. Draw four lines in the same four ways.

13. Draw five lines in the same way.

14. Draw freehand a horizontal line of any length. Draw a vertical line of equal length. Test your work.

15. How many straight lines can be drawn through a given point?

16. Make four points, not in the same line. Call them *a*, *b*, *c*, and *d*. How many straight lines can be drawn connecting every two of these points?

17. From each point draw a line to each of the other points. From each point how many lines will you draw? Will any of them coincide with lines already drawn?

GEOMETRY.

1. When n stands for the number of points, show that the formula $\frac{n\ (n-1)}{2}$ will indicate the number of lines that can be drawn connecting every two points.

2. Using the formula, find the greatest number of straight lines that can be drawn through 6 points not in the same straight line. 8 points. 24 points.

3. Write the definition of quadrilateral. Draw as many different kinds as you can. Describe each by a definition.

4. It is often necessary to measure the length of lines. To do so a unit of measurement is chosen. Name some of these.

5. Lines are compared in length by measuring them. Take the dividers, and get a unit of measurement.

6. Draw a horizontal line, and then a vertical line equal to it. By the dividers test your lines.

7. $><$ are the signs of inequality. $a > b$ is read, a is greater than b. $a < b$ is read, a is less than b.

8. Draw four lines of unequal length, and number them a, b, c, d. Test their lengths, and write results, $a < b$; $b > d$; etc.

9. Draw two lines, AB and CD. Extend AB indefinitely through B. On the extended line from B, by means of the dividers, take a length $BE = CD$. The line AE is called the sum of AB and CD.

10. Draw two lines, AB and CD. By using the dividers, on AB take a length $AE = CD$. The line ED is called the difference of AB and CD.

11. Draw a line, AB. Extend AB indefinitely through B. On the extended line take a length $BC = AB$; take another length $CD = AB$. Then $AC = 2\ AB$; and $AD = 3\ AB$.

12. Draw a line, AE. Divide it into four equal parts marked by B, C, and D. Then is $AB = \frac{1}{4}$ of AE and $AC = \frac{1}{2}$ of AE.

GEOMETRY.

1. Lines can be added, subtracted, multiplied, and divided.

2. Draw two lines, AB and CD. Draw another, EF, equal to their sum. Draw another, GH, equal to their difference.

3. Draw a line, AB, and prolong it to C, making AC equal to 5 AB.

4. Draw a line; divide it freehand into 3 equal parts. Into 4, 6, 8 equal parts.

5. Draw a line: divide it freehand into 7 equal parts. Test your work.

6. Draw two lines whose ratio shall be 1 : 2; 1 : 4; 1 : 6.

7. Draw two lines whose ratio shall be as 2 : 3; 3 : 4; 2 : 6.

8. What is meant by drawing to a scale?

9. How long would you draw a line to represent 20 in., using a scale 1 : 8?

10. How many centers can a circle have? How many circles can have the same center?

11. Can a plane surface and a curved surface be parallel? Draw a straight line and a curved line that shall be parallel.

12. If I use a scale of $\frac{1}{4}$ in. to a foot, what ratio do I use?

13. What is the standard unit of length in this country?

14. Draw to a convenient scale lines representing 130 ft.; 250 yd.; 75 rd.

15. What scale did you use?

16. How many lines parallel to a given line can be drawn through a point outside of the line?

ANGLES.

17. Take the dividers, and open the points one inch.

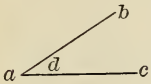
18. Do the legs of the dividers now point in the same direction or in different directions?

19. Draw lines to represent the legs of the dividers.

20. These lines are said to make an angle.

GEOMETRY.

1. What is an angle? An angle is the difference in direction of two lines.



2. In this figure the lines *ab* and *ac* are called the sides of the angle. The point where these lines meet, as at *a*, is the vertex.

3. Define vertex.

4. The angle in 2 is named by reading the angle *d*, or the angle *c a b*.

NOTE. — When you use the three letters, where is the letter at the vertex always placed?

5. Draw this figure on paper. Name and read the angles. How many are there?



6. Is it necessary to put 4 letters at the point where the lines cross?

7. Suppose you have placed *o* at the center, and speak of the angle at *o*, should I know which angle you mean?

8. How could you make me understand that you mean the angle at the top?

9. From one point draw three lines so as to form two angles. Do these angles lie near each other so as to touch or have one side in common? Such angles are called adjacent angles.

10. Define adjacent angles.

11. Draw two lines perpendicular to each other. The angle you have formed is called a right angle.

12. Define a right angle.

13. Draw the line *OA*. Now draw *OB* in a direction exactly opposite *OA*. This is called a straight angle.

14. A straight angle is equal to how many right angles? All straight angles are equal to one another.

15. Draw two lines that shall meet but not be perpendicular to each other. The angle formed is an oblique angle.

GEOMETRY.

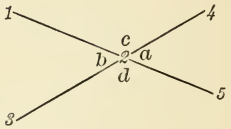
1. Define an oblique angle.

2. Is the angle you have formed less than a right angle? If so, it is an acute angle.

3. Define an acute angle.

4. Is the angle you have formed greater than a right angle? If so, it is an obtuse angle.

5. Define an obtuse angle.



6. In this figure read the angles, using the figures; using the letters.

7. What angle is opposite a? c?

8. Do these angles have the same vertex, and are the sides of the $\angle a$, also the sides of the $\angle b$, extended through the vertex? If so, they are vertical or opposite angles.

9. Define vertical angles.



Fig. 1.

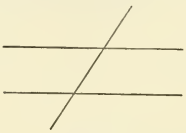


Fig. 2.

10. Draw these figures on the board and on paper. Name all the angles.

11. In Fig. 1 all the angles are what kind of angles?

12. In Fig. 1 name all the adjacent angles; all vertical or opposite angles.

13. In Fig. 2 are all the angles of the same kind? If there are any, name the right angles, the acute angles, the obtuse angles, the adjacent angles.

14. Look at a cube. What kind of angles do you find?

15. On a square prism? A triangular prism? A square pyramid?

16. At 2 o'clock what angle do the hands of a watch make? Where must the hands be to form a vertical angle with the first position?

17. At 9 o'clock what angle do the hands make?

GEOMETRY.

1. What kind of an angle does a vertical line make with a horizontal one?

2. Starting at 12 o'clock, in what time will the hands of a clock be at right angles to each other?

3. Draw a circle, and in it draw two diameters perpendicular to each other.

4. How many right angles have you?

5. Pin the circle through the center to a cardboard. By rotating it, prove that the arcs are equal. Each of these right angles is measured by what part of the circumference of the circle?

6. To measure a line we take a line of a certain length, called a foot, as a unit. To measure a circumference we take a length which is $\frac{1}{360}$th of it as a unit. This we call a degree. Every circumference is divided into how many degrees?

7. How are angles measured?

8. Draw several angles, and measure them by using a protractor. First estimate their size before measuring.

9. Using your protractor, make an angle of 45°; 60°; 90°; 30°; 150°; 135°; 100°; 40°; 20°.

10. Draw several angles, and by means of the protractor make other angles equal to each of them.

11. By means of dividers make an angle equal to a given angle.

NOTE. — As when using the protractor, your given angle must first be measured.

12. Draw an angle. Using protractor, make another angle twice the size of the given angle. Do the same, using dividers.

13. Draw an angle. Make another angle of $\frac{1}{2}$ the size; of four times the size.

14. Draw a horizontal line, AB. At a point in the line, C, draw an oblique line that shall not cut AB. Measure the angles. Add their result. What is the sum? What ought it to be?

GEOMETRY.

1. Do the same after drawing one vertical and two oblique lines.

2. Draw three lines cutting each other at one point. How many angles are formed? Measure them. Add results. What is the sum? What ought it to be?

3. Draw two adjacent angles. Measure each of them. Add results. What is the sum?

4. Draw a four-sided figure. Estimate the angles of the figure. Record your estimate in one column; the true value, found with a protractor, in another; and the error in a third column.

5. Substituting a five-sided figure, repeat 4.

6. Substituting a six-sided figure, repeat 4.

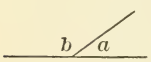
7. If the sum of two adjacent angles is a straight angle, each is called the supplement of the other.

8. When the sum of two adjacent angles is 180°, and one of the angles is a right ∠, what is the other?

9. If one of the angles is an acute ∠, what is the other?

10. If one of the angles is known, how is the other found?

11. Find the supplement of each of the following angles: 40°; 75°; 95°; 125°; 15°; 65°; 175°; 97°; 110°; 25°.



12. If a measures 45°, how many degrees does b contain?

13. At a given point, c, in a line AB, construct an angle of 60°, and one of 70°. How many degrees will there be in the third angle?

14. At a given point, c, in a line AB, construct two angles. Measure one of them. How many degrees in the other one?

15. Using a protractor, erect a perpendicular at each extremity of a horizontal line; of an oblique line; of a vertical line.

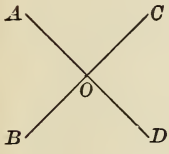
16. Draw a vertical line. Using protractor and ruler, construct a square upon this line.

GEOMETRY.

1. Draw two vertical angles. Measure them. How do they compare?

2. Write: Two vertical angles are always equal to each other.

3. Prove that two vertical angles are equal to each other.



Prove that $\angle AOC = \angle BOD$.

Measure and test as in Lesson 117–5.

$\angle AOC + \angle COD =$ ——. Why?

$\angle COD + \angle BOD =$ ——. Why?

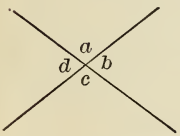
What common angle can you take away?

What must be true of the remainder?

4. One of four angles formed by two intersecting lines measures 90°. What does each of the others measure?

5. When one measures 100°, what does each of the others measure? 36°? 45°? 20°?

6. Draw two intersecting lines. Measure one of the angles formed. Determine the others.



7. Prove that the angle a equals the angle c. Prove that the angle b equals the angle d.

8. Draw a horizontal line, AB. At one extremity draw a line making an angle of 60°; at the other extremity a line making an angle of 40°.

9. Draw a vertical line, AB. At one extremity draw a line making an angle of 75°; at the other end a line making an angle of 100°.

10. Draw a line, AB. At a point, C, in this line draw six equal angles. Are any of these angles adjacent? Are any vertical?

11. Draw two angles, one of 55°, and the other of 85°. Draw a third angle equal to the sum of these. Draw a fourth equal to their difference.

12. How many degrees are passed over by the minute hand of a clock in a quarter of an hour? in 20 min? in half an hour? in an hour?

GEOMETRY.

1. How many degrees are passed over by the hour hand of a clock in an hour? in 3 hours? In how many hours will the hour hand pass over 90°?

2. Draw a horizontal line, AB. Draw two lines, CD and EF, perpendicular to AB. Where will CD and EF meet? Why?

3. Draw a horizontal line, AB, and at each extremity draw an oblique line, making with AB an angle of 45°. Where will the two oblique lines meet? Why?

4. Draw a vertical line, AB. At each extremity draw two oblique lines, each making an angle of 75° with AB. Where will the oblique lines meet? Why?

5. Draw an oblique line, AB. Draw two lines, CD and EF, making with AB an angle of 65°. Will these oblique lines meet?

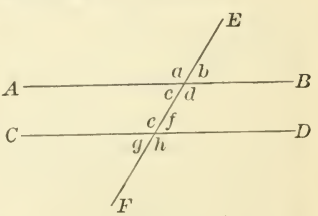
6. Draw a horizontal line, AB. Draw two lines, CD and EF, making respectively angles of 45° and 75°. If you produce the two oblique lines, will they meet?

7. Draw a horizontal line, AB. Draw an oblique line, CD, making with AB an angle of 60°. Draw EF parallel to AB, and cutting CD. Draw GH parallel to CD, and cutting AB. Mark in each angle the number of degrees it contains.

8. Draw two parallel lines, AB and CD, and an oblique line, EF, cutting them. How many angles are formed?

How many lie within the parallel lines? Name them. These are called Interior Angles.

Name the four angles without the parallels. These are called Exterior Angles.



9. An exterior and an interior angle, as b and f, having different vertices, and lying on the same side of the intersecting line, are called Corresponding Angles, or Exterior-Interior Angles.

ANGLES.

1. Two exterior angles, as b and h, or two interior angles, as c and e, having different vertices, and lying on the same side of the intersecting line, are called Exterior or Interior Angles on the same side.

2. Two exterior angles, as b and g, or two interior angles, as d and e, having different vertices, and lying on different sides of the intersecting-line, are called Alternate-Exterior and Alternate-Interior angles.

3. Name the four pairs of corresponding angles; of opposite angles.

4. Name the two pairs of Alternate-Exterior angles; of Alternate-Interior angles.

5. Which angles are equal?

6. The sum of what two are equal to two right angles?

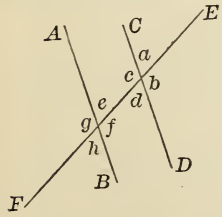
7. How many of the eight angles do you need to know to determine the others?

8. If two parallel lines are cut by a third, prove that corresponding angles are equal.

9. Prove that the sum of b and e is two right angles.

10. Prove that alternate angles are equal.

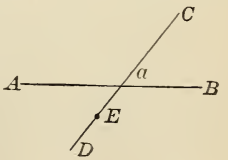
NOTE. — Conceive AB to move, keeping parallel to its first position, until it corresponds with CD. What angles then coincide?



11. AB and CD are parallel lines cut by the line EF.

If a measures 50°, how many degrees does each of the other angles measure?

12. AB is a straight line cut by another line, CD. E is a point in the line CD. At E make an angle equal to a by drawing line, FG. What relation in position has FG to AB? Why?

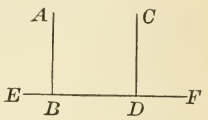


GEOMETRY.

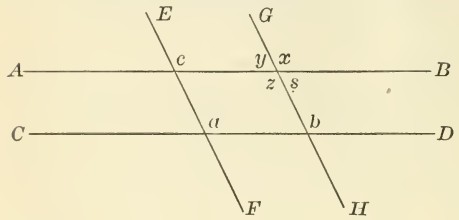
1. Prove that if two straight lines are cut by a third line so that two corresponding angles are equal, then the lines must be parallel.

2. Prove that if a straight line is perpendicular to one of two parallel lines, it is also perpendicular to the other.

3. Using this figure, prove that if two straight lines are both perpendicular to a third line, they are parallel.



NOTE. — Lines can be conceived to change their positions, and be moved so as to correspond with other lines.



4. $AB \parallel CD$ and $EF \parallel GH$. (This reads AB is parallel to CD, etc.)

a. How do the sides of the angle *a* compare with the sides of the angle x? y? z? s?

b. If the sides are parallel, do they all have the same direction?

c. If all do not have the same direction, do any of them?

5. Prove that if two angles have their sides respectively parallel, and directed the same way from the vertex, the angles are equal.

NOTE. — Make use of your knowledge of corresponding angles.

6. Prove that if two angles have their sides respectively parallel and directed opposite ways from the vertex, the angles are equal.

NOTE. — Make use of the preceding proposition, and your knowledge of vertical angles.

7. Prove that if two angles have their sides respectively parallel, and directed, one pair the same way, the other pair opposite ways, from the vertex, the sum of the angles is two right angles.

NOTE. — Use proposition 5, and Lesson 119–3.

GEOMETRY.

1. Prove 5, 6, 7, of Lesson 122, by means of a new figure lettered differently.

2. If a is 75°, find the value of x. Of y. Of z. Of s.

3. What relation exists between a and s? Prove it.

4. Prove that any two of the angles are equal, or else their sum is 180°.

5. Draw two parallel lines; cross them with two oblique parallels. Letter the angles and compare them.

REVIEW.

6. Define angle; vertex.

7. How is an angle named? Give an illustration.

8. When are two lines perpendicular to each other?

9. When are two lines inclined?

10. How is the equality of two angles tested without placing one of them on the other?

11. By what instruments are angles measured?

12. Describe a protractor.

13. Define adjacent angles. Draw two.

14. When is one angle the supplement of another?

15. What difference in the size of an angle does the length of the sides make?

16. Define vertical angles. Draw two.

17. Prove that two vertical angles are equal.

18. Draw a straight line intersecting two parallel lines. Point out the external angles; internal angles; corresponding angles; opposite angles; alternate angles.

19. Prove that corresponding angles are equal.

20. Prove that alternate angles are equal.

21. Prove that if two straight lines are cut by a third line so that two corresponding angles are equal, then the lines must be parallel.

REVIEW.

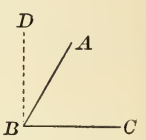
1. What is the ratio of one rt. $\angle$ to 4 rt. $\measuredangle$?

2. What is the ratio of one-fourth of a rt. $\angle$ to 2 rt. $\measuredangle$?

3. How can you test whether two intersecting lines are perpendicular to each other?

4. Make an angle. Make another angle 3 times as large. Make another $\frac{1}{4}$ as large.

5. What must be added to ABC to make a right angle? The angle ABD is called the complement of ABC.



6. When is one angle the complement of another?

7. Draw an angle. Make its complement.

8. What is the complement of an angle of 25°? 35°? $37\frac{1}{2}$°? 45° 60°? 75°?

9. Draw two parallels, AB and CD; intersect them with two oblique parallels. How many different angles?

10. Letter them. Compare them as follows: $\angle a = \angle b = \angle c$, etc.

11. An angle formed by a vertical line meeting a horizontal line is an angle of —— degrees?

12. Draw an angle that is equal to one-half of a right angle.

13. Draw a right angle. Cut from it an angle of 25 degrees. How many degrees are there in the remaining angle?

14. Draw a quadrilateral that is not a parallelogram.

15. Draw an equilateral rectangular parallelogram.

16. Draw a rhombus having an angle of 75°. Write the number of degrees in each of the other angles.

17. What is the supplement of an angle that is $\frac{2}{3}$ of a right angle?

18. How many degrees has an angle whose supplement is 4 times as large as the given angle?

19. Must a right angle have an obtuse or an acute angle for its supplement?